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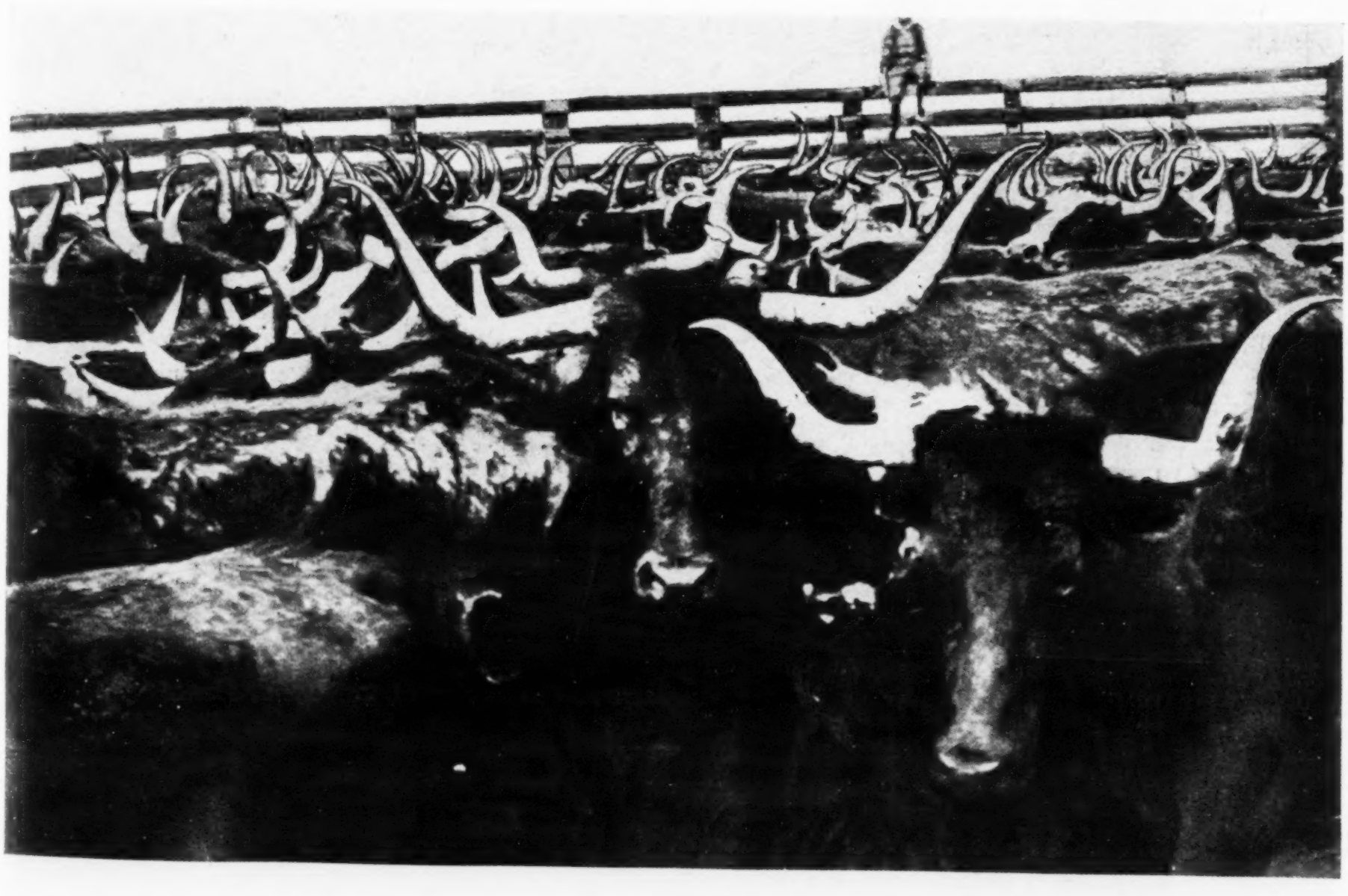

Long-Horns of Long Ago

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A Tri-Generic Cross
C. E. Leighty and W. J. Sando

Analysis of Breeding Phenomena
D. Kislovsky

The Pink-Fleshed Pummelo of Java

October, 1927 Vol. 18, No. 10

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Photograph by David Fairchild

METHOD OF SERVING THE PINK-FLESHED PUMMELO

Frontispiece

The empty rind at the left shows clearly the thickness of the skin and the large oil glands on its surface, but a photograph can give you no idea of the delicate pink color of the inside lining. One of the segments on the plate is broken open to show the very large follicles. It is amusing to pull off these glistening morsels one at a time, and they are so dry one can do it without soiling the fingers. The photograph was made on our hotel veranda with an antique Japanese batik for background

THE PINK FLESHED PUMMELO OF JAVA

DAVID FAIRCHILD

MY first acquaintance with the pink fleshed pummelos (or shaddocks*) of Java was made on a boat crossing from Batavia to Singapore in 1899. A fellow American occupied the same cabin with me and he had bought one somewhere in a Javanese market. I had seen many shaddocks with pale pink flesh, but this one was as bright a pink as a mixture of claret and water. Those I had seen before had not much impressed me because the pink was too pale, and not as attractive as the bright sparkling greenish-yellow of our American grapefruit. This fruit made a lasting impression on my mind because of its bright color and because it could be eaten with the fingers without getting them sticky. It was aesthetically very entertaining to eat and I wished that I had seen it before, when I might have procured cuttings.

When in 1926 I found myself again in Java I looked about for this deep pink fleshed pummelo but did not find it in the Buitenzorg market. It was not until I visited the fashionable residential town of Bandoeng that I saw it again. One was served in the hotel where I stopped.

It was a most attractive fruit—quite as interesting as I remembered finding it 27 years before. It was served under the name of the *Djcrock Bali*. It was a delight to pull off the tough *delicate pink* colored skin which enclosed each of the fruit segments and tear apart the large brilliant pink follicles. It gave me the same kind of pleasure that my first acquaintance with the grapefruit had in the early nineties when my friend Swingle introduced me to it in our boarding house in Washington—before it had become a well-known fruit in America. The follicles or pulp vesicles of the pummelos are unusually large and separate from each other very easily and when held in the hand these pink ones are objects quite as beautiful as any garnets, and I could almost say quite as dry to the touch. They have a refreshing flavor and a crispness which is delightful even though they do not contain very much juice—nothing comparable to that in a good grapefruit. Mrs. Fairchild was as interested as I was in the fruit.

My friend P. H. Dorsett who was with me, did not draw with his evening meal a fruit with quite so deep colored flesh as mine. His impression was not as a consequence as favorable as mine. Still I am confident that he shares our opinion as to the desirability of its introduction into America.

Upon enquiry at the hotel in Bandoeng we found that this so-called *Djcrock Bali* was grown everywhere in the private gardens of the town and we later visited one of these gardens and cut budwood from a tree and sent it to Washington. Unfortunately it did not survive the journey of 45 days, wrapped in wax paper and sphagnum moss, neither did the few seeds which were saved from the especially-fine specimen which we ate at the hotel.

However, we were fortunate enough to find at the native market of Kediri, fruits with almost as brilliant pink flesh as the Bandoeng fruit and the seeds which we sent from this lived and have grown into small seedlings under Mr. May's care in the Citrus Quarantine Station at Bethesda, Maryland. (Expedition No. 77 S. P. I. 67641)

Other Varieties

Upon our return to Buitenzorg I visited the Plant Propagating Garden

*The earliest recorded introduction to America of fruit of this general character was made by one Capt. Shaddock, hence the West Indian name "Shaddock Tree" used by Hans Sloane in 1696. According to Sloane the seed were first brought to Barbados.

METHOD OF SERVING THE PINK-FLESHED POMMELO

Frontispiece

'The empty rind at the left shows clearly the thickness of the skin and the large oil glands on its surface, but a photograph can give you no idea of the delicate pink color of the inside lining. One of the segments on the plate is broken open to show the very large follicles. It is amusing to pull off these glistening morsels one at a time, and they are so dry one can do it without soiling the fingers. The photograph was made on our hotel veranda with an antique Japanese bottle for background

of the Department of Agriculture over which Dr. Ochse has charge, and saw there the excellent work going on with citrus and other fruit stock plants and noted that the Department is propagating a number of varieties of pummeloes. The young assistant in direct charge, Mr. Magielse, showed me various cases of citrus canker among his citrus plants and I learned from him that Dr. Reinking, one of the leading American plant pathologists, had just been there and corroborated the diagnosis of the Dutch specialists with regard to the presence of the disease in Java. This fact so seriously complicated the problem of getting grafted plants of the various varieties of shaddock seedlings that I decided to postpone the shipment of a wardian case of citrus fruits until special arrangements could be made to secure disease-free plants, and accordingly I sent only seed of disease-free fruits. With a fruit normally self-pollinating as with most of the citrus fruits there is every probability that a large majority of the seedlings thus secured will reproduce the parental type.

Dr. Ochse later on brought to the hotel specimens of the various sorts of the pink fleshed pummeloes, and I must say that I do not believe any Florida grapefruit grower could have resisted them. They were so large and beautifully round with extremely large oil glands and seemed to be in quite a different class as a fruit from that occupied by the grapefruit.

While there are many more or less distinct varieties of these pink pummelos in Java, the three which Dr. Ochse is propagating for distribution in the kampongs and plantations are the following. I quote from my notes made at the time:

Djerock Bali—Fruit almost globular; dark green; rind light pink inside ¼ inch thick; flesh not strictly pink, at least very slightly so; flesh sweet but insipid. This fruit does not seem to agree with the Djeroek Bali which was given me in Bandoeng.

Djerock Pandan Wangi (see illustration)—Fruit globular, lighter green; inner skin light pink, pinker than in Djeroek Bali; flesh deep pink, dry and mildly acid, almost faintly acid; drier than Bali; the partitions are colored bright pink; very large follicles. A desirable variety for home gardens and for use in fruit salads. (Seeds of this variety were sent under Allison V. Armour Expedition Nos. 795 and 810 [S.P.I. 68022 and 62905] and these are now growing in the Citrus Detention Station, Bethesda, Maryland.)

Djerock Delima—Inner part of skin is only slightly pink; flesh lighter pink than Pandan Wangi but juicier; not so attractive; little flavor and of no better taste.

Uses For the Pummelo

What use Americans will make of the pink fleshed pummelo, once it is thoroughly introduced and is growing in many private gardens, I am too old a Plant Introducer to venture to predict, for they have found so many new ways of utilizing fruits. Unlike the common West Indian shaddock, usually of high acidity and juicy, the Oriental pummelos are as a class rather sweet and solid. The most obvious use for the pummelo which occurred to me as I sat eating them on the veranda of the Bellevue Hotel in Buitenzorg, overlooking one of the most superb tropical landscapes in the world, was as a fruit salad ornamentation. They would give a touch of brilliant transparent color to any fruit salad, which could not fail to be attractive. Dr. H. J. Webber has suggested that it would add a very valuable element of color to the canned grapefruit which is already, I understand, a commercial success. Personally I am inclined to think the color would not hold, but should his surmise be correct there is a good chance of the Javanese Pink Fleshed Shaddock "arriving" as one says, in the Commercial World. A canning test of some white-fleshed pummelos fruiting at Little River, Florida, was made a few years ago. The result, as recorded by T. Ralph Robinson, was entirely successful. The solidity of the flesh results in the pummelo segments retaining unimpaired their form and texture, under the processing treatment, a considerable advantage when intended for salads.

Whether the pummelo "arrives" or not, I for one want a few trees of it on my own place in South Florida, and I am sure there are many others who will be glad to work over some of their superabundant grapefruit trees to this attractive visitor from the Malay Archipelago.

Genetics and Animal Breeding

COMPARED with the great number of genetics textbooks, there are relatively few textbooks of animal breeding and this discrepancy appears still greater if we use for measurement the quality of the books in these two fields. The new book by Adametz* doubtless represents a valuable addition to the literature of animal breeding and probably for years to come will remain one of the most reliable sources of information for those interested in problems of livestock breeding; it will be equally useful and stimulating for the geneticists working in other fields.—The book consists of seven chapters. The first chapter deals with the descent of the domestic animals (cattle, horses, sheep, goats, swine and dogs). The second chapter reviews the problems of "breeds and general breed characters"; it contains a clear and concise discussion of the conception of "breed," sets forth the reasons for the author's systematical arrangment of the different breeds into groups of primitive, pure-bred, and transitional breeds and the causes for the decline and degeneration of breeds. The third chapter gives a report of the influence of environmental factors upon the body conformation of the domestic animal (climate, training, nutrition). The fourth chapter is devoted to genetics and the fifth to the application of the results of genetics to problems of practical breeding. The sixth chapter describes in detail the different methods of animal breeding (pure-breeding, line-breeding and cross-breeding) and the last chapter gives an intimate account of the means and methods of selection for livestock breeding.

On the whole, the book is characterized by an unusual clearness and by a well balanced presentation of the facts. Personal convictions play an important rôle in the chapter concerning the descent of the domestic animals, and their appreciation must be left to specialists in this field. The genetics part of the book is relatively short but correct and probably sufficiently complete for the understanding of the problems with which practical breeders usually will have to deal.

To the geneticist the chapters concerning the methods of animal breeding and of selection will be of special interest and value. An unusual amount of facts and partially new observations are embodied in these chapters. In certain details the majority of the geneticists probably will dissent from the author's statements. To some of these instances, I should like to refer here. The color of the white Leghorn fowl, Adametz wants to have recognized as a case of "Leuzismus" (unpigmented feathers, pigmented skin), and on account of its dominance puts it into one series with the white color of horses and the silver color of karakuls (Shiras sheep), there are, however, other breeds of fowls with unpigmented feathers and yellow skin in which the white behaves as a recessive (White Minorakas). The mutation of Drosophila Adametz calls "Domestikationsmutationen," although there is no evidence that the rate of mutations is increased under culture conditions; the fact that in the laboratory mutations frequently

*Leopold Adametz, *Lehrbuch der allegemeinen Tierzucht.* Julius Springer. Wien, 1926.

survive which perish in nature, often seems to lead to the inference that there really are more mutations taking place in the labortary. Hemophilia Adametz calls a lethal factor; strictly speaking, however, we even cannot include it in the group of semilethals. It should be mentioned that the present usage of the term "sex-limited factors" includes the secondary sexual characters. In several instances, it appears from the text that important publications have remained unknown to the author. Thus, in describing the inheritance of the crest in canaries mention is not made of the fact that in homozygous condition it represents a lethal factor (Duncker); the correlation between oestrus condition at the time of fertilization and the sex proportion in cattle reported by Pearl and Salaman was later revoked by Pearl; in reviewing the results of the work of Agnes Bluhm, the author does not refer to the contradictory results of MacDowell although these are based on a many times greater number and a superior method; in the criticism of the work of van der Malsburg, one misses reference to the publications of Walther and Rensch, and so on.

Throughout the book considerable emphasis is laid upon chondrodystrophy (anchondroplasia) as a breed character although there is no case yet on record in which the typical histological features of the skeleton characterizing chondrodystrophy could be shown convincingly as a breed character; the paper by Plattner concerning the dachshund to which Adametz apparently refers, is very superficial. The dachshund as well as in other similar instances could at best be spoken of as a chondrodystrophic constitution although even this may be misleading as long as there is no proof of a casual relationship between this constitution and chondrodystrophy proper.

The book contains no references to the literature. The reader thus is left entirely to the authority of the writer. A textbook should make an attempt to enable the willing student to read a part of the original literature and encourage him to find further information about problems in which he may be particularly interested.—In spite of these details, it must be emphasized that with the publication this book Adametz has performed a distinct service to the fields of genetics and animal breeding. The great number of very instructive original pictures deserve highest praise.

—Walter Landauer.

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BIRTH RANK OF MONGOLIANS

Mongolism, a Definite Form of Mental Deficiency, Found More Frequently in the Higher Birth Ranks

GEORGE ORDAHL

Psychologist, Sonoma State Home, Eldridge, California

TWO types of mental deficiency are particularly distinguishable by their physical appearance: The Cretin and the Mongolian. There is a resemblance between these two types, but this resemblance is superficial and tends to disappear when the distinguishing characteristics are known.

Cretinism is caused by defective thyroid secretion. The physical and mental conditions may be relieved if thyroid extract is administered early in the life of the patient.

It seems probable that with Mongolism, as with Cretinism, there may be some endocrine disturbance, but thus far research has revealed little that is definite, and no cure or method of alleviation has been discovered. The idea quite generally prevails that Mongolism tends to occur in children born late in large families or when the mother is nearing the end of the childbearing period. There is, however, not any general agreement on the details, and further data are desirable.

I have, therefore, tabulated such data as could be obtained from 159 families, in which Mongolism is found, which might have etiological significance. The information has been got from admission blanks supplemented in many cases by interviews with the parents.

Status of Parents

All parents interviewed were evidently of good normal intelligence.

Sixty-seven of the families pay in whole or in part for the support of their Mongolian child. Ninety have been adjudged by the court unable to meet this expense.

Rated on the basis of the United States Army occupational intelligence standards, the parents of the Mongolians are distributed as follows: Thirty-nine of the fathers are engaged in occupations requiring a median intelligence of C—; 91, C; 16, C+; 11, B; 0, A. "Housewife" is the classification of 130 of the mothers, while five had occupations classed as C+; 7 as B and 0 as A. For seven no data were obtained.

While these ratings do not positively exclude persons of inferior intelligence, they show that the parents of Mongolians are engaged in occupations requiring average intellectual capacity and would indicate that their industrial efficiency and social status are at least average.

Family Histories

The family histories show mental disease and mental deficiency in the 159 families, through four generations, as follows:

Generation	Feeble-minded	Insane
1	8	2
2	1	6
3	6	9
4	0	1

One family of three children included two Mongolians—a brother and a sister—while the firstborn sib is also reported as defective. The above data probably show less mental deficiency and insanity than actually exist. For various reasons, persons are sometimes loath to report on the mental condition of their relatives.

So far as our data indicate, the forebears of the Mongolian show no marked variations in general health and vigor. The diseases experienced and the causes of death are about the same as expected in the population as a whole.

Of the grandparents, 280 in number, on whom there is some information, 68 died of "old age," 31 of pneumonia, 22 of heart failure and 18 of tuberculosis.

The median age of these grandparents at death is 68½ years. The youngest at death is 25, the oldest 100.

Thirteen of the fathers are reported as alcoholic, 14 others moderately so, while four of the grandfathers and two of the grandmothers are reported as alcoholic.

Personal Peculiarities

The Mongolian is so low in intelligence that he is usually referred to as an idiot. The median IQ for 126 institutional cases examined is 23. The lowest IQ is 4, the highest 45. Approximately half are idiots and half are imbeciles.

Mongolians resemble each other so closely in facial expression and bodily stature as to be taken for members of the same family. They are no less alike in temperament and disposition. Making allowances for some exceptions, the Mongolian is docile, imitative, active, happy and mild-tempered. He is, however, a physically weak and immature or dwarfed person.

The median age for talking is 3 years 5 months. The youngest began at 9 months, the oldest at 12 years.

The median age for walking is 3 years 1 month. The youngest began at one year, the oldest at 12 years.

The median age for eruption of first tooth is 1 year 1 month. The youngest had a tooth at 5 months, the oldest at 6 years.

The average age at death is 19.5 years. The oldest at death was 44 years, the oldest living is 52. The youngest in the institution is 6 months.

All the Mongolians on which I am reporting are or have been inmates of an institution. There are 55 now living and in the institution, 11 have been discharged, 94 are dead. Of 106 deaths, 28 are from tuberculosis, 43 from pneumonia and 10 from heart complications.

Birth Rank

The median age of the mother at birth of the Mongolian child is 37½ years. The youngest was 16, the oldest 54. The median age of fathers is 39 years, the youngest being 19 and the oldest 63.

The order of birth of the Mongolian varies from first and only child in the family to twelfth and last. The following table presents the order of birth, the number of children in the family and the number of firstborn, furnished pro rata:

TABLE I

No. of children in family	*No. of families*	*No. of first-born furnished pro rata*
2	20	10.00
3	25	8.33
4	22	5.50
5	14	2.80
6	17	2.83
7	13	1.85
8	12	1.50
9	11	1.22
10	6	.60
11	4	.36
12	4	.33
13	3	.23
14	1	.07
	152	35.62

In other words, if a Mongolian were as likely to be born in one birth-rank as in any other, the 20 families of two children each ought to furnish 10 first-born Mongolians, only if *all* the children were Mongolians—this figure must be weighted by the *percentage of* Mongolians in our whole population, or in the population at large—the six families of 10 children each ought to furnish 0.60 Mongolians, and so on.

The actual birth-rank was not known in 20 of our cases, therefore they are omitted from Table II, which shows how far below expectation the Mongolians are, in the earlier birth-ranks, and how much above expectation they are in the later ranks. Column B gives the theoretical expectation of, say, first-borns, if a Mongolian were as likely to be born in one birth-rank as another. Column A gives the actual number of Mongolian first-borns in our material.

To simplify comparison, I have given

the ratios in Column C, which represents 100A divided by B. It is at once observed that while the first and second-born, for instance, appears less than two-thirds as frequently as would be expected if birth-rank were not significant, the older places in large families appear twice as often as one would expect.

Thus, while the first child in a family may be a Mongolian, the tendency as exhibited in this series increases steadily and rapidly as one reaches the higher birth-ranks. Fifty-six (that is, 60%) of 91 cases are last-born. The families, however, range from two to twelve, the average being approximately five children for each family.

Further studies should take into account not only the actual birth-rank of the child and the age of the parents, but also the interval between births, diseases, constitutions of parents, and any other factors which could bring about a condition such as might be explained by "uterine exhaustion," which is the most commonly advanced reason for Mongolism.

TABLE II

Order of birth	*No. of Mongolians* (A)	*Theoretical expectation* (B)	*Ratio of observed to expected* (C)
1	22	36	61
2	23	36	64
3	20	26	77
4	13	14.34	75
5	10	11.84	84
6	19	9.04	210
7	12	6.21	193
8	9	4.36	206
9	4	2.86	139
10	4	1.64	243
11	1	1.04	96
12	3	0.68	441

Brothers in Baseball

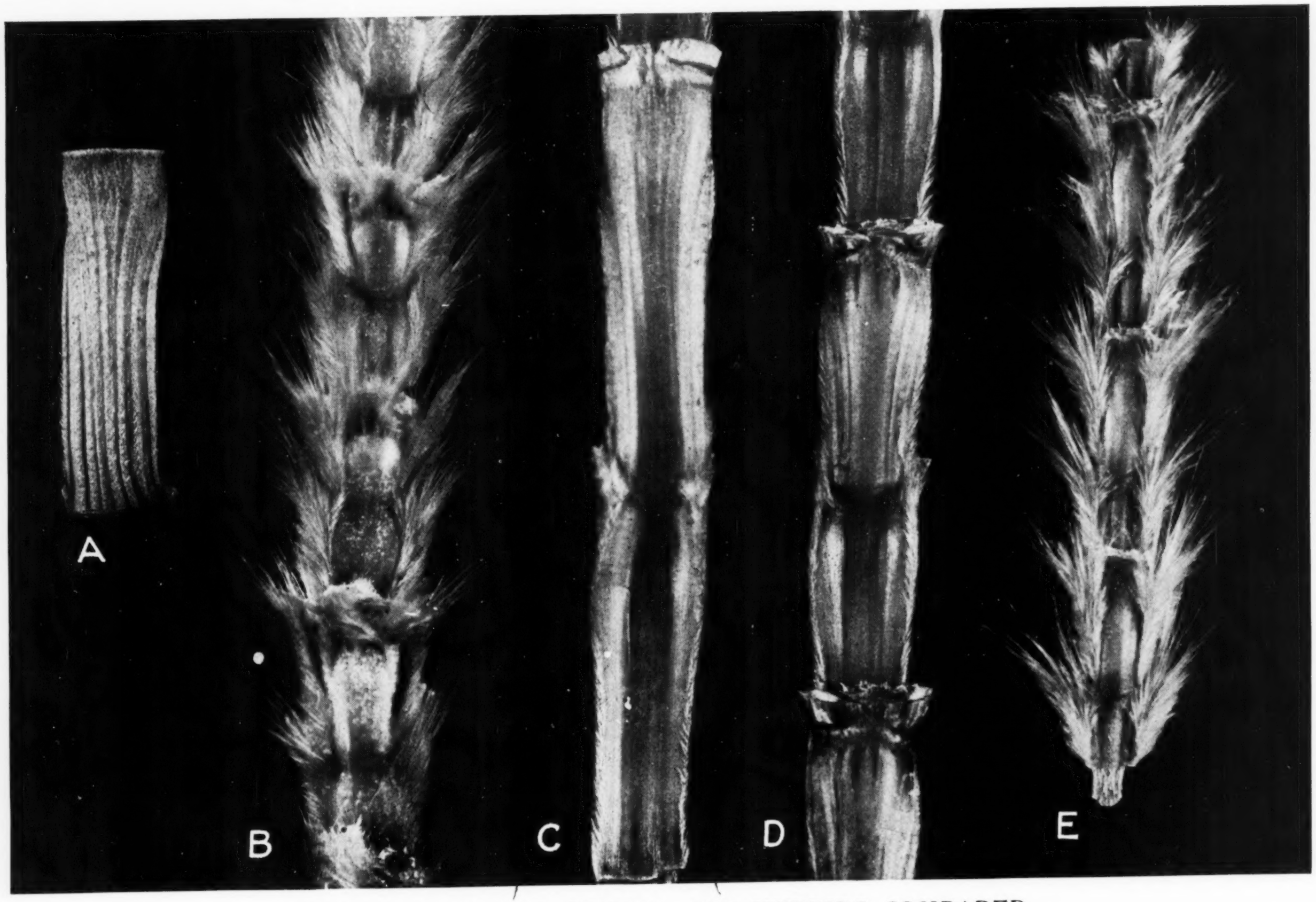
THE passing of Emil (Irish) Meusel from the Brooklyn Dodgers to the Toledo club of the American Association has broken another of the famous major league "brotherhoods."

Through half a dozen baseball campaigns Emil vied with his brother, Bob Meusel of the Yankees in the matter of slugging, twice, while Irish Meusel was with the Giants, he opposed his brother in world's series games. Emil Meusel once was considered the most dangerous hitter on the Giants, but at 34 he was found too slow for the Brooklyn club, which only a few days ago gave him his unconditional release. The Toledo Mudhens, leading the American Association race, signed him to play in the outfield.

Other brother acts continue in the majors, however, the most illustrious of the current season being the Waner duo of Pittsburgh—Paul and Lloyd. The Cleveland Indians have Luke and Joe Sewell, University of Alabama products, who are playing the catching and shortstop positions. The Barnes brothers are still in the box scores, Jess pitching for the Boston Braves and Virgil being the ace of the Giants' staff.

Other brothers have had their share of service in the majors and have passed to slower company. Claude Jonnard once pitched for the Giants while his brother caught for the Pirates. Bill Killifer, once a famous catcher with the Chicago Cubs, was receiving Grover Cleveland Alexander's slants while his brother Wade, now a manager in the Pacific Coast League, was an outfielder with the Giants and Cubs. Ivy Wingo, catcher for the Cincinnati Reds for many years, is a brother of the Wingo now with the Detroit Tigers. The Yankees once had Milt Gaston, now pitching for the St. Louis Browns, while the Giants owned Alex Gaston, the catcher.

The Meusels were the only pair of brothers who were outfielders. Bob is hitting at a good clip with the Yankees.—*By the Associated Press.*



RACHIS OF THREE GENERA AND HYBRIDS COMPARED

Figure 1

Portions of the rachis (A) *Aegilops ventricosa*, (B) *Triticum turgidum*, (C) *Aegilotricum* hybrid, *A. ventricosa* ♀ × *T. turgidum* ♂, (D) *Aegilotriticale* hybrid, (*A. ventricosa* ♀ × *T. turgidum* ♂) ♀ × *S. secale* ♂, (E) *Secale cereale*. The long rachis joint of the Aegilops parent is fully dominant in the primary or *Aegilotricum* hybrid, *A. ventricosa* × *T. turgidum;* the bristles on the edges and apex of the joints are somewhat intermediate in the hybrid. When the primary or *Aegilotricum* hybrid is crossed with *S. cereale* both the length of rachis joint and the bristles are intermediate in the *Aegilotriticale* hybrid.

A TRIGENERIC HYBRID OF AEGILOPS, TRITICUM AND SECALE

C. E. LEIGHTY and W. J. SANDO,

Office of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture

A HYBRID involving three genera is exceedingly rare and difficult to produce. In connection with the experiments conducted by the writers in the hybridization of wheat and related forms such a hybrid has been obtained, with the parentage (*Aegilops ventricosa* ♀ × *Triticum turgidum* ♂) ♀ × *Secale cereale* ♂. Tschermak[3,4] has reported a hybrid combining the three genera, Aegilops, Triticum and Secale in its parentage, apparently the result of natural crossing between an Aegilops-Triticum hybrid and a Triticum-Secale hybrid. For this he suggests the name "Aegilotricale." The name "Aegilotriticale," however, has been adopted for the form reported herewith, as it indicates more clearly the presence of Triticum in the parentage. Tschermak also suggests the name "Aegilotricum" for the Aegilops-Triticum hybrid.

Crossing Methods

All of the crosses herein reported were made in a greenhouse on the Arlington Experiment Farm, near Washington, D. C., and all of the parental and hybrid plants were likewise grown there. A common method used in hybridizing wheat was employed, that is, several upper and lower spikelets of the head and all the flowers but the lower two on each of the remaining spikelets were removed before blooming began. The remaining flowers were emasculated and enclosed in glassine bags. After an interval of a few days the bags were removed and the desired ripe pollen applied to the stigmas of the flowers. The heads were then again enclosed in glassine bags until maturity.

Description of Parents*

Aegilops ventricosa

A. ventricosa (Figures 1 to 5) is one of about 12 species belonging to the genus Aegilops. It is found growing wild in countries bordering the Mediterranean Sea, especially Spain, France, and northern Africa. It has a decumbent habit of growth. When grown in the greenhouse at Arlington Farm the culm attains a length of about 60 cm. The culm is thin-walled (Figure 4A).

The leaves are narrow and of a lighter green color than those of the several other species of Aegilops grown under the same conditions. The upper and lower surfaces and the edges of the leaf blades are abundantly covered with hairs. The leaves are also scabrid. The leaf sheaths are usually devoid of hairs though occasionally a few may be produced. Numerous hairs are also developed on the edges of the leaf sheath.

The spikes are from 7 to 11 cm. long and are composed of from 5 to 10 very compact spikelets (Figures 2A and 5A). Each spikelet consists of 2 to 4 flowers, only the lower two of which produce seed. The apical spikelet and one or two of the lowest spikelets are

*For the purpose of assisting in differentiating certain more or less similar morphological characters of the parents and hybrids, terms are used which are defined as follows:

A *bristle* is a slender stiffish acicular process .2 to 3 mm. long.

A *hair* is a slender more or less distinct, flexible, filiform process .2 to 2 mm. long.

Barbed—furnished with rigid claw-like points .3 to 1 mm. long.

Scabrous—covered with small rigid antrorse points, .2 mm. or less in length.

Portions of the rachis (A) *Aegilops ventricosa*, (B) *Triticum turgidum*, (C) *Aegilotricum* hybrid, *A. ventricosa* ♀ × *T. turgidum* ♂, (D) *Aegilotriticale* hybrid, (*A. ventricosa* ♀ × *T. turgidum* ♂) ♀ × *S. secale* ♂, (E) *Secale cereale*. The long rachis joint of the Aegilops parent is fully dominant in the primary or *Aegilotricum* hybrid, *A. ventricosa* × *T. turgidum*; the bristles on the edges and apex of the joints are somewhat intermediate in the hybrid. When the primary or *Aegilotricum* hybrid is crossed with *S. cereale* both the length of rachis joint and the bristles are intermediate in the hybrid

usually undeveloped and produce no seed. At maturity the rachis disarticulates at the nodes, the spikelet separating from the joint which bears it, but remaining attached and fitted into the joint facing it (Figure 5A). These spikelets with attached joints are 10 to 11 mm. long.

Each of the coriaceous, inflated glumes has 6 to 7 prominent, scabrous nerves, is 8 to 10 mm. long, and bears a scabrous awn and a short tooth. (Figure 4A). The awns on the glumes vary from 4 to 30 mm. in length. The lemmas are scarious and smooth, except for a small exposed portion at the tip of the spikelet which is scabrous like the glumes. The scabrous awns on the lemmas in general are longer than those on the glumes, the length ranging from 8 to 40 mm. The rachis internodes are scabrous on the exterior convex surface and edges.

The pressure exerted by the two outer glumes of the spikelet causes the lemma and palea to become so firmly attached to the seeds which they enclose that a seed is rarely obtained devoid of a portion of them.

Triticum turgidum

The plants of *T. turgidum* variety Alaska have an upright habit of growth and attain an average height of 127 cm. when grown in the greenhouse at Arlington Farm. Both surfaces of the leaves are pubescent but not to the extent found in *A. ventricosa*. Hairs are absent from the margin of the leaf blades except at the auricles. The culm is thick-walled and supports a compound spike 8 to 12 cm. long (Figures 4B, 2C), composed of many two- to five-flowered spikelets. The glumes have only a semblance of a beak and are glabrous, inconspicuously nerved, glaucous, and slightly inflated, with a distinct keel (Figure 4B). The lemmas, which are longer than the glumes, are glaucous where exposed and are terminated by a single black scabrous awn 1 to 14 cm. long (Figure 5B). The rachis is tough, non-disarticulating, glabrous on its exterior surface, and abundantly fringed with bristles along its edges (Figure 1B). At the apex of each of its internodes and directly below the point of contact of the spikelet with the rachis is a collar of similar bristles (Figure 5B). The rachis internodes are from 4 to 6 mm. long (Figures 5B, 1B).

Secale cereale

Two varieties of rye, Abruzzes and Rosen (*S. cereale*), were used in the production of the "Aegilotriticale" hybrid herein reported. The plants of these varieties have an erect habit of growth and attain a height of 152 cm. when grown in the greenhouse at Arlington Farm. The upper and lower surfaces of the leaves are glabrous and the blade is devoid of hairs on its edges. The culms are thick-walled and support spikes which bear on an average 38 spikelets each (Figures 4E, 3C). Each spikelet is composed of 2 or rarely 3 flowers (Figure 5E). The glumes are 8 to 12 mm. long, narrow, rigid, subulate-pointed, and 1 nerved (Figure 4E). The lemmas are 10 to 15 mm. long, with sharp, barbed keel, and 5 inconspicuous nerves, and taper into a scabrous awn 1 to 6 cm. long (Figure 5E). The rachis is made up of non-disarticulating internodes 2 to 4 mm. long with short bristles on the edges and at the apex (Figures 1E, 5E). The peduncle is hairy directly below the spike.

The Bigeneric Cross and the "Aegilotricum" Hybrid

In the bigeneric cross of the trigeneric hybrid referred to above, 50 flowers of *A. ventricosa* were pollinated with pollen of *T. turgidum* variety Alaska. Eighteen seeds were obtained which produced seven F_1 plants. Various treatments were given these seven plants, some being backcrossed with the parents and with other wheats and rye, while still others were carefully isolated or selfed by enclosing their heads in glassine bags before blooming. On one plant a bagged head set one seed; on another three heads produced

a total of nine seeds. When the F_1 plants were crossed with different *vulgare* wheats from 5 to 10 per cent of the flowers pollinated produced seeds. Anthers on some plants were certainly observed to dehisce.

The F_1 of the *Aegilotricum* hybrid between *A. ventricosa* and *T. turgidum* at first glance does not appear to be intermediate between the two parents (Figure 2B). However, a more detailed inspection of its morphological characters indicates that each parent contributes about half of the dominant characters. Some of these dominant characters and the parents from which they are inherited are shown in Table 1.

The hybrid plant attains an average height of 86 cm., which is intermediate between the Aegilops and Triticum parents, these being 60 and 127 cm. in height, respectively. The leaf blades are hairy on both the upper and lower surfaces and on the edges near the base. The leaves are also scabrid. The culms are thick-walled, though not as much so as in the wheat parent (Figure 4C). The spikes are slender like those of the Aegilops parent, but are longer than those of either parent, the length ranging from 12 to 17 cm. (Figure 2B). The average number of spikelets to the head is 15. The spikelets are less compacted than in the Aegilops parent (Figure 5C). They are composed of 3 to 4 flowers, are longer than the rachis internode and are usually devoid of seed, though an occasional selfed seed may be produced in those flowers whose anthers dehisce. Anther sterility, however, is almost entirely the rule. An occasional crossed seed may be produced when wheat or rye pollen is applied.

The glumes are 8 to 10 mm. long, glaucous, and terminated by a short awn or beak, which rarely exceeds 1 cm. in length (Figure 4C). The nerves on the glumes are less conspicuous than on those of the Aegilops parent and are scabrous.

The lemma is terminated by 3 teeth, the middle of which is extended into a black scabrous awn 2 to 9 cm. long. The lemma is smooth except the upper exposed portion, which is glaucous and scabrous. The rachis joints are 10 to 11 mm. long, with short bristles on the edges and at the apex (Figures 1C, 5C).

The Trigeneric Cross, and the "Aegilotriticale" Hybrid

The secondary cross involved the hybridization of the F_1 of (*A. ventricosa* × *T. turgidum*) ♀ with *Secale cereale*. This was undoubtedly the more difficult hybrid to obtain. As the F_1 plants of the primary cross were almost completely sterile, the flowers of these plants were not emasculated before being cross-pollinated. In addition to the initial application of rye pollen, usually considered sufficient in making hybrids, the flowers were subjected to several later pollinations until it appeared certain that their period of receptivity had passed.

From a total of 8 heads of a single F_1 plant pollinated with rye pollen, 16 kernels were obtained. From these kernels only two plants (F_1 of secondary cross) were produced, and these were similar morphologically. Since both of these plants had hairy peduncles, a character inherited from the rye, it is certain that these were true hybrids. If the primary hybrid, *A. ventricosa* × *T. turgidum*, functions normally we should expect a number of different phenotypes in a cross between it and *S. cereale*. As only two plants were produced it has not been possible to ascertain whether normal segregation takes place or whether we have here a case of a non-splitting hybrid. The Aegilotriticale hybrid has an upright habit of growth and attains an average height of 150 cm. The upper and lower surfaces of the leaves are sparsely hairy and scabrid. A few hairs are produced on the edges at the base of the blade. The narrow spikes are 10 to 13 cm. long, and consist of 24 to 28 two- or three-flowered spikelets, of which the one or two lowest are imperfectly developed (Figure 3B). The culms are thick-walled (Figure

SPIKES OF AEGILOPS, WHEAT, AND PRIMARY HYBRID

Figure 2

Spikes of (A) *Aegilops ventricosa*: (B) F_1, *Aegilotricum* hybrid, *A. ventricosa* × *T. turgidum*, (C) *Triticum turgidum*, variety Alaska. Fifty flowers of Aegilops were treated with wheat pollen and the eighteen seeds resulting produced seven plants. An analysis of the individual characters shows that each of the parent genera has contributed about half of those that are dominant.

SPIKES OF THE TRI-GENERIC HYBRID AND THE PARENT FORMS

Figure 3

Spikes of (A) F_1, *Aegilotricum* hybrid, *Aegilops ventricosa* ♀ × *Triticum turgidum* ♂, (B) F_1 *Aegilotriticale* hybrid, (*A. ventricosa* ♀ × *T. turgidum* ♂) ♀ × *S. cereale* ♂. (C) *Secale cereale*, variety Abruzzes. Two plants of the trigeneric hybrid were obtained from sixteen kernels produced by crossing rye with the Aegilotricum hybrid. It has not been possible to cross rye and Aegilops directly and the production of an intermediate hybrid to make otherwise incompatible crosses may be a means of producing forms not possible by direct methods.

4D). The glumes are narrow, glaucous, 8 to 10 mm. long, with 3 to 4 scabrous nerves and a single scabrous awn or beak 3 to 4 mm. long (Figure 4D).

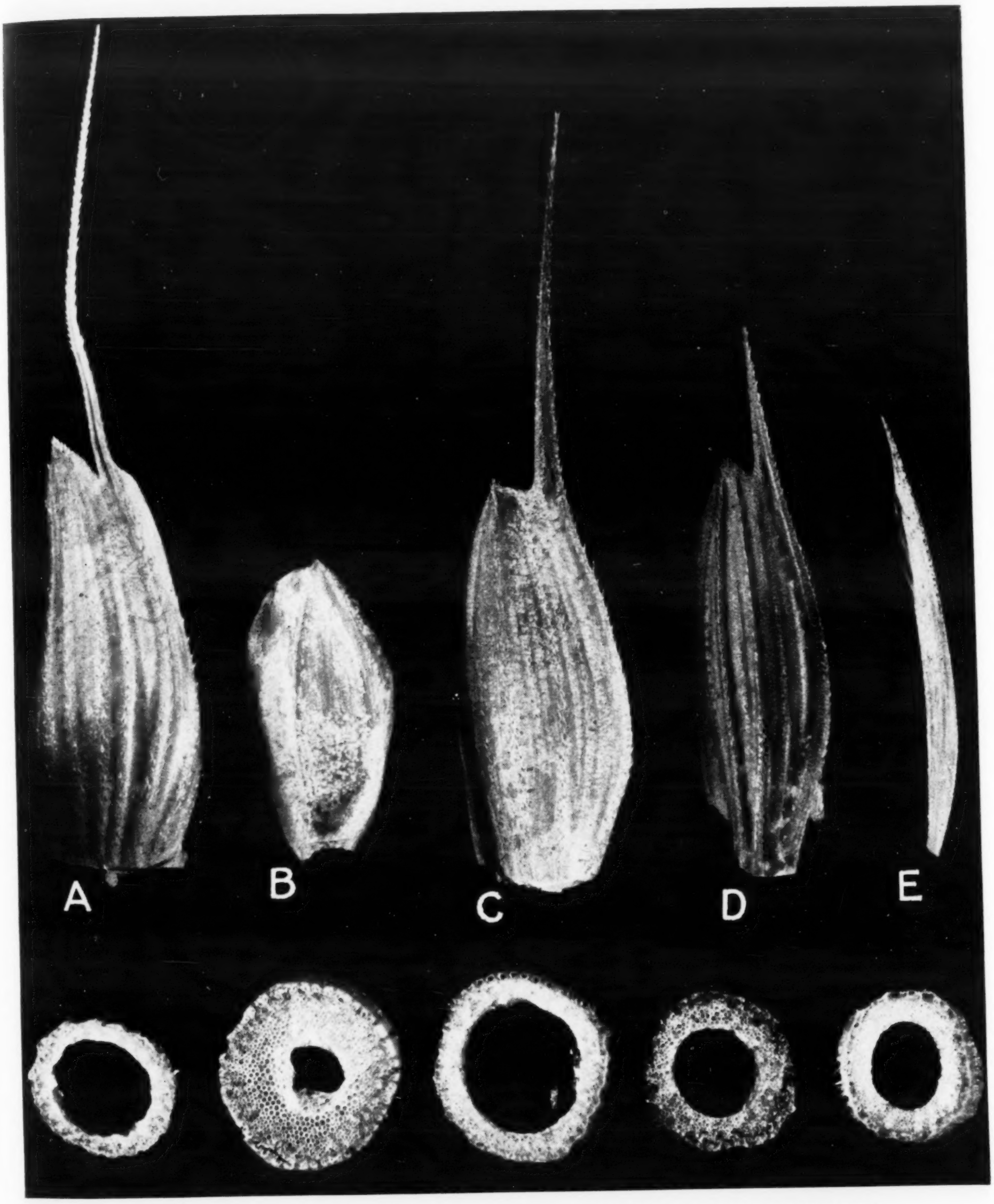
The lemmas are smooth except on the exposed portion at the apex, which is glaucous and scabrous-nerved. Each lemma is terminated by 3 teeth, the middle one of which is extended into an awn 2 to 8 cm. long.

The rachis is non-disarticulating and is composed of several joints, each of which is 6 to 7 mm. long (Figures 1D, 5D). On the edges and apex of the rachis joints are short bristles (Figures 1D, 5D). On the upper portion of the peduncles directly below the base of the head are numerous hairs ¼ to ½ mm. long. The plants are self-sterile, and repeated attempts to cross the Aegilotriticale hybrid with various forms of Triticum, Aegilops, and Secale have been without result. In these hybrids dominance of most of the characters is rarely complete, but is expressed in a modified degree. Certain characters of the trigeneric hybrid listed in Table II are very definitely inherited from Aegilops and Triticum, respectively. The prominent nerves, tooth and beak of the glumes, and the scabrous exterior surface of the rachis joints of Aegilops are plainly expressed in the trigeneric hybrid. The glaucousness of the rachis joints and the glumes, and the keel on the glume of the Triticum parent are likewise definitely transmitted to the trigeneric hybrid.

The expression in the trigeneic hybrid of many characters of Triticum and Aegilops indicates the feasibility of combining indirectly the characters of two individuals which, for certain unknown reasons, probably chromosome incompatibility, cannot be combined by direct crossing. Many flowers of *A. ventricosa* have been pollinated with rye pollen without producing a single viable seed.

The irregular functioning of the chromosomes in hybrids between two genera of the family Gramineae has been observed by several investigators. Sax[1] crossed *A. cylindrica* with *T. vulgare* and made observations on the chromosome number and behavior in the hybrids. *A. cylindrica* has 14 and *T. vulgare* 21 haploid chromosomes. Seven Aegilops chromosomes were found presumably to pair with 7 Triticum chromosomes, leaving 21 single chromosomes, 7 of which were from Aegilops and 14 from the Triticum parent. The bivalents were found dividing normally, but the univalents were apparently distributed at random without dividing in one of the reduction divisions. This hybrid was found to be sterile and Sax attributes this to the incompatibility of certain chromosomes and to chromosome differences in the parents. Tschermak and Bleier[4] in cytological studies of F_5 and F_6 plants from the crosses *Aegilops ovata* × *Triticum diccoccoides* and *A. ovata* × *T. durum* found 28 chromosomes as the haploid number. The parents of these two crosses each have 14 haploid chromosomes. These hybrids behave like normal plants. With the exception of the large chromosome number the divisions do not differ from those in the parent plants. Furthermore, it does not appear that the chromosomes in the first metaphase are distributed over the whole spindle, as in the case of the sterile "Aegilotricum" hybrid described by Sax and Sax[1]. The late arrival of individual chromosomes at the poles frequently observed in the heterotypic division cannot be considred abnormal, as this phenomenon is also observed in the parents. In the tetrad stage small deeply stained bodies are commonly seen in the cytoplasm. It is possible that these are lagging chromosomes. The fertility, non-splitting character, and large size of the hybrids as compared with sterile forms are attributed to the doubling of the chromosome number. The F_1 plants of the two crosses referred to above were more or less fertile, and fertile forms were produced in later generations.

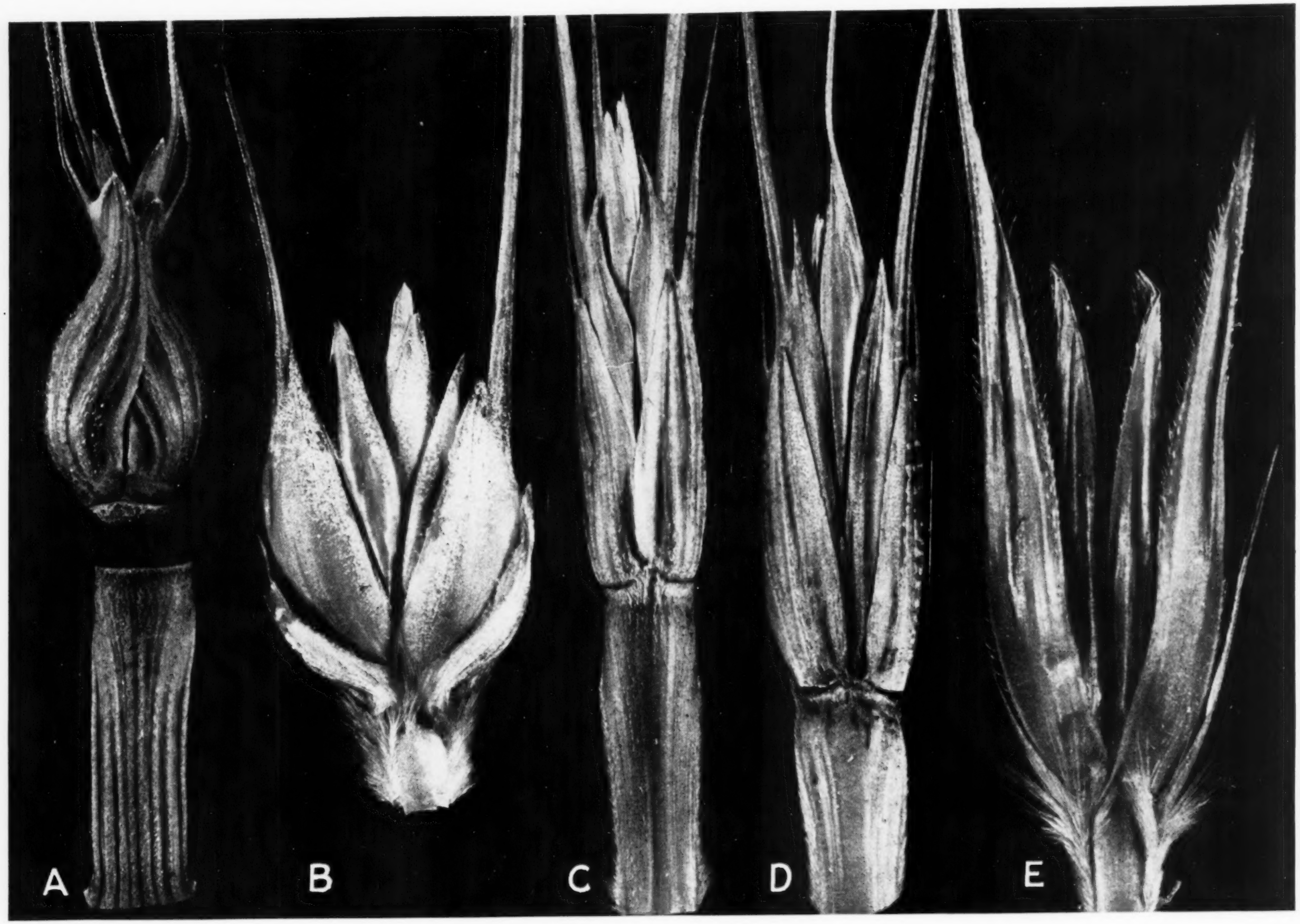
Thompson[2] crossed *T. vulgare* having 21 haploid chromosomes with *S.*



GLUMES AND CULMS OF PARENT GENERA AND HYBRIDS

Figure 4

Glumes (above) and cross sections of Culms of (A) *Aegilops ventricosa,* (B) *Triticum turgidum,* (C) F_1 *Aegilotricum* hybrid, *A. ventricosa* ♀ × *T. turgidum* ♂, (D) F_1, *Aegilotriticale* hybrid (*A. ventricosa* ♀ × *T. turgidum* ♂) ♀ × *Secale cereale* ♂, (E) *S. cereale.* The prominent tooth, beak and nerves, and the scabrousness of *A. ventricosa* are expressed in the glumes of the hybrids.



THE SPIKELETS COMPARED

Figure 5

Spikelets with rachis joints of (A) *Aegilops ventricosa*, (B) *Triticum turgidum*, (C) F_1, *Aegilotricum* hybrid, *A. ventricosa* ♀ × *T. turgidum* ♂, (D) F_1, *Aegilotriticale* hybrid (*A. ventricosa* ♀ × *T. turgidum* ♂) × *Secale cereale* ♂, (E) *S. cereale*.

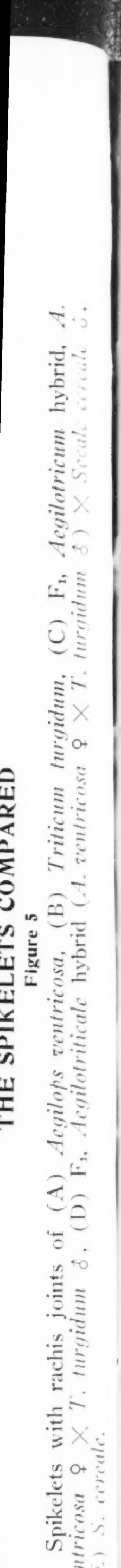
cereale having 7 chromosomes. In the first reduction division of the F_1 he found usually 28 univalent chromosomes which moved to opposite poles without dividing. Often he observed one to three bivalents which divided in a characteristic fashion with considerable irregular behavior of the lagging chromosomes. The second division was usually more regular than the first, but at times was equally irregular. "The F_1 is very vigorous and not quite completely sterile."

In the trigeneric cross reported herein the genera involved and their respective haploid chromosome numbers are as follows: *Aegilops ventricosa* 14, *Triticum turgidum* 14 and *Secale cereale* 7.

In the bigeneric cross (*A. ventricosa* × *T. turgidum*) some of the hybrids obtained occasionally produced a few seeds when selfed.

In the trigeneric cross (*A. ventricosa* × *T. turgidum*) × *S. cereale*, two plants were obtained, but no seeds were produced from pollinations with various Triticums and with Secale.

No cytological studies were made of the hybrids referred to above, but from the irregular chromosome behavior of the intergeneric hybrids reported by Sax and Sax, Tschermak and Bleier, and Thompson, it is highly probable that even more complex phenomena might be observed in the Aegilotriticale hybrid herein reported.



THE SPIKELETS COMPARED

Figure 5

Spikelets with rachis joints of (A) *Aegilops ventricosa*, (B) *Triticum turgidum*, (C) F_1, *Aegilops ventricosa* ♀ × *T. turgidum* ♂, (D) F_1, *Aegilotriticale* hybrid (*A. ventricosa* ♀ × *T. turgidum* ♂) ♀ × *S. cereale*.

Summary

A hybrid of the parentage (*Aegilops ventricosa* ♀ × *Triticum turgidum* ♂) ♀ × *Secale cereale* ♂ has been obtained.

The F_1 of the Aegilotricum or bigeneric hybrid, *A. ventricosa* × *T. turgidum*, was cross-pollinated with *S. cereale* pollen, 16 kernels resulting, from which two plants of the "Aegilotriticale," or trigeneric hybrid, were produced.

These plants were similar morphologically, both having pubescent peduncles, a character undoubtedly inherited from rye, and were entirely sterile.

Other characters from rye and also characters inherited from the Triticum and Aegilops parents were present in the Aegilotriticale hybrid plants.

It has not been possible to cross *A. ventricosa* and *S. cereale* directly.

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2. Thompson, W. P. Chromosome behavior in a cross between wheat and rye. *Genetics* 11(4):317-332. 9 fig. 1926.

3. Tschermak, E. Ungewollte fremdbestäubung bei sog. Selbstbestäubern unter den Kulturpflanzen. *Wiener Landw. Zeitung* 75:235-236. 1925.

4. ————————, and Bleier H. Uber fruchtbare Aegilops-Weizenbastarde. *Berich. Deut. Bot. Gesel.* 44:110-132, 7 fig. 1926.

TABLE I—Some Dominant Characters of the F_1 Hybrid, Aegilops ventricosa × Triticum turgidum, and the Parent from which the Factors for the Respective Characters were Inherited.

	Aegilops	*Triticum*
Non-disarticulation of rachis		+
Long rachis joints	+	
Bistles on edges and apex of rachis joints		+
Non-ramification of spike	+	
Upright habit of growth		+
Thick walls on culms		+
Hairs on edges of leaf	+	
Short tooth on glumes	+	
Long beak or awn on glumes	+	
Scabrous glumes	+	
Prominent nerves on glumes	+	
Keel on Glumes		+
Glaucous glumes		+
Long awn on lemmas		+
Black pigment in awns		+

TABLE II—Some Characters of the Aegilops, Triticum, and Secale Parents and of the Bigeneric and Trigeneric Hybrids between Them. (+ = Presence, − = Absence of Character named.)

	Aegilops ventricosa	×	*Triticum turgidum*	=	Bigeneric hybrid	×	*Secale cereale*	=	Trigeneric hybrid
Prominent nerves on glumes	+		−		+		−		+
Scabrous nerves on glumes	+		−		+		+		+
Tooth and beak on glumes	+		−		+		−		+
Scabrous rachis joints	+		−		+		−		+
Bristles on edge and apex of rachis joints	−		+		+		+		+
Erect habit of growth	−		+		+		+		+
Thick walls on culms	−		+		+		+		+
Glaucous rachis joints and glumes	−		+		+		−		+
Keel on glumes	−		+		+		−		+
Hairs on peduncles	−		−		−		+		+

Nordic Humility

IN the slow and gradual evolution of man from the anthropoid ape, covering as it does some hundreds of thousands of years, and always advancing from the lower to the higher, it is impossible to avoid recognizing the evidences of design, and realizing that the unknown power which has previously moulded the Jew, the Latin, the Hindoo, the Polynesian, and the Australian, is now moulding the Anglo-Saxon and the Teuton, according to some well-defined laws of which we at present have but a dim conception. But we may go farther than this, and see that the same Power which is developing the characteristics of our race also developed the ant, the bee, the bird, and the mammal. The Teuton has, by reason of his superior powers of observation, gained a greater knowledge of the operation of these laws than any of the older races, but they were not wholly unrecognized by these races. In the story of the child Samuel we may recognize the Jewish idea of the working of this Power. The Spirit of the Lord was believed to speak through the child. . . . . . . The Hebrew Scriptures are so many-sided that there is much to be found in them to support this view, and yet the Hebrew philosophers just failed to attain to that higher conception of the unity of nature which our science discloses to those who can comprehend its teachings. The lesson to be drawn from this is that, superior as our race undoubtedly is to any of the older races, this superiority does not justify us in setting up any absurd claims to Divine favour. The latest born of the races is the heir of all the ages, and has inherited the higher faculties of the races which have preceded it; but this is because the plan of the Creator requires that the younger should be superior to the older, and that the course of evolution should be from the lower to the higher, and there is no proof that we are any nearer to the Creator, or of any more importance in His sight, than the meanest worm which crawls on the face of the earth. The pride of race characteristic of many of the older races is justified by their belief that they were specially created by the god or gods or that they were the peculiar race of the god or gods, but the Anglo-Saxon who asserts such a belief would proclaim himself an ignorant man. Pride of race was natural to the Jew, the Chinese, the Latin. It is ridiculous in the Anglo-Saxon. We are simply travelling in the footsteps of the older races until we arrive at the place where they stopped, when we proceed a few steps farther before we stop also.

The Anglo-Saxon by George Boxull, pp. 42 and 44.

THE TEXAS LONGHORN PRESERVED FROM EXTINCTION

WILL C. BARNES,
U. S. Forest Service

"GERONIMO"*—AN OLD-FASHIONED LONGHORN

Figure 6

For many years he was a well known resident of the Forth Worth stockyards. At one time it looked as though he might be able to pose as one of the last of his race, but a recent appropriation by Congress makes provision for the preservation for this type which is historically interesting if no longer economically important.

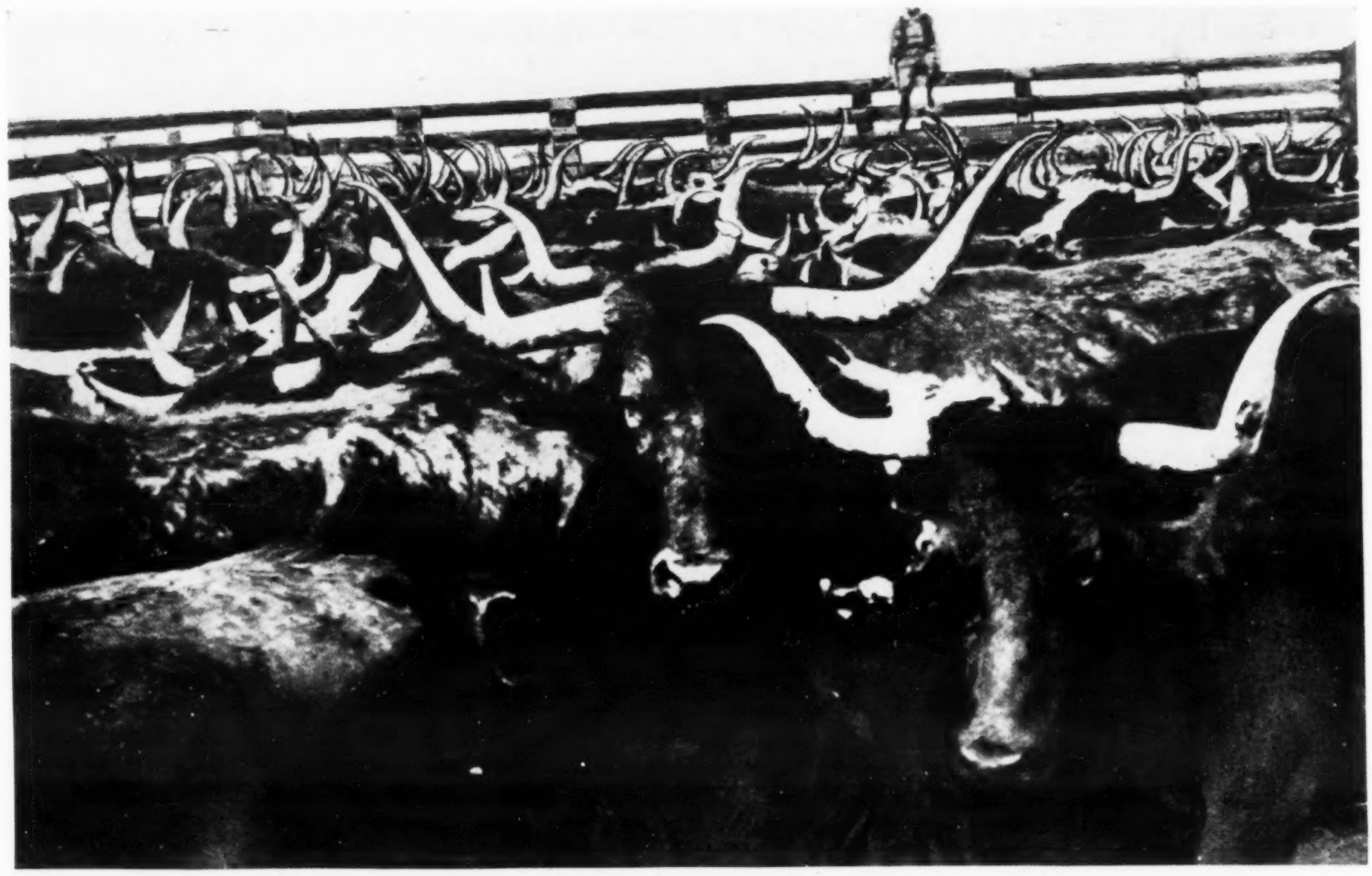
THE Indian, the Buffalo, and the Longhorns of the Western Plains are a trio about which cluster worlds of sentiment, romance, pioneer lore and history.

Contrary to general understanding the Indian is thriving, for today we probably have more of that race than existed when the first pilgrims bumped their boat against the rocky point of Cape Cod.

The buffalo, too, has been saved

*The name "Geronimo" given the steer pictured at the head of this article involves an odd story. In the December, 1925, issue of the *National Geographic Magazine* was an article by Alvin H. Sanders called "The Taurine World." Mr. Sanders appealed to the writer to assist him in finding a photograph of one of the old time Longhorns. In the annual report of the Bureau of Animal Industry of the U. S. Department of Agriculture for 1899 there was a picture of such a steer taken from a photograph. The animal was called "Geronimo" by the government writer. The illustration was copied by a local photographer and sent to Mr. Sanders together with the text below the illustration in the old report.

Three years later an old time trail boss, Mr. George W. Saunders of San Antonio, Texas, wrote the Editor of the *Geographic Magazine* to the effect that the picture was not of



LONG HORNS EN MASSE

Figure 7

A herd of longhorns in the Fort Worth stockyards. Once the most important breed of range cattle, the longhorns have given way before the more productive beef types.

from extinction through the unselfish work of a few New York men belonging to the American Bison Society. Under the leadership of Dr. W. T. Hornaday, they donated to the Federal government 16 head of buffalo from the New York Zoological Gardens as a nucleus for a herd of those animals in the Southwest where, in the Wichita National Game Preserve in Oklahoma, they have thrived wonderfully as well as in other places where herds have been established. We now have more buffalo than we have room for and in a way buffalo are a drug on the market.

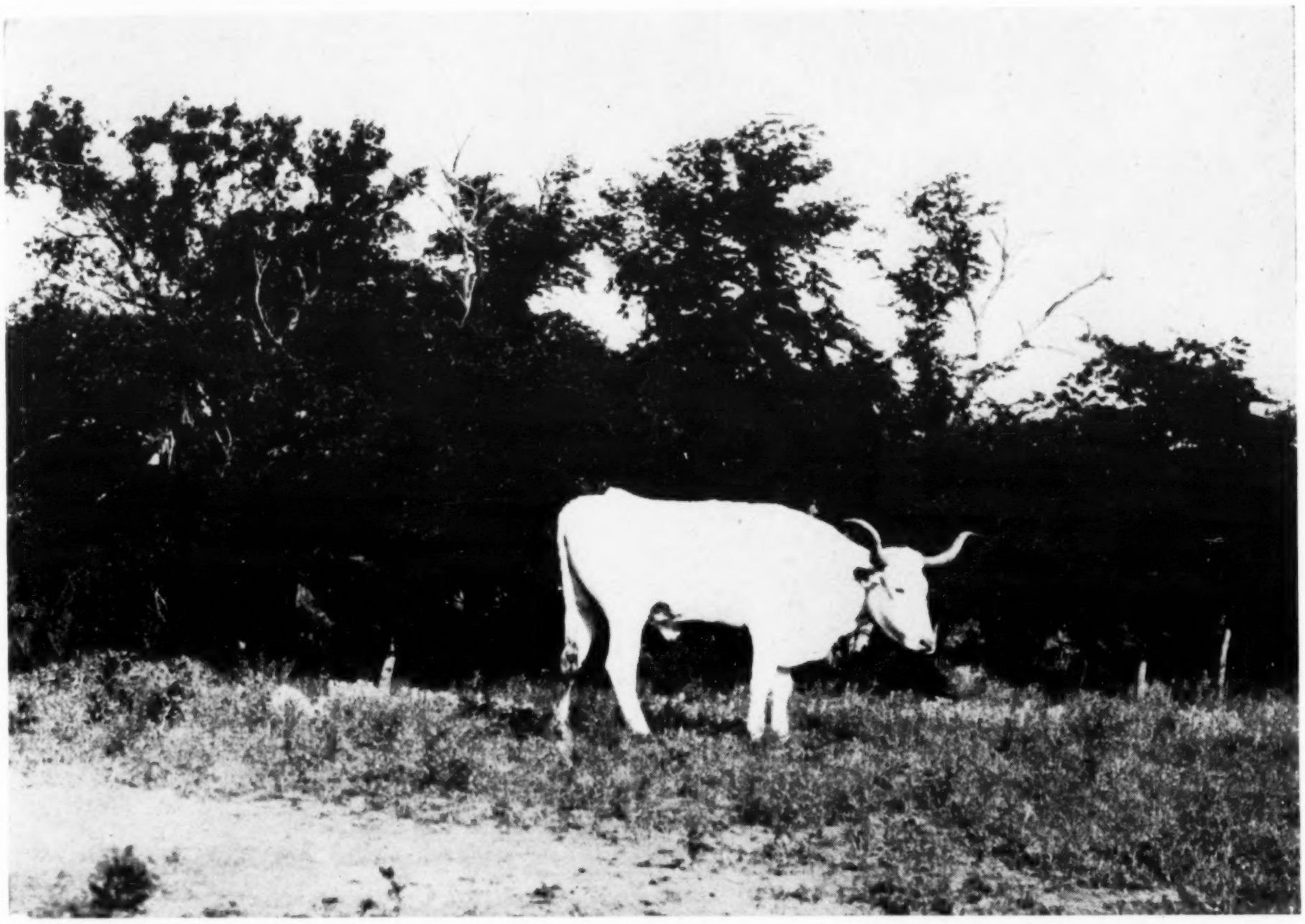
But it has looked as if the third member of this famous trio were really doomed to become totally extinct.—either gone like the Passenger Pigeon—or threatened with extinction as is the Heath Hen of Massachusetts.

For ten years officers of the United States Forest Service have been trying to interest somebody in this matter. Every one was interested until it came to furnishing funds for securing the Longhorns. Congress seemed deaf to all arguments for furnishing the few thousand dollars needed.

Down in the Wichita Mountains in southwestern Oklahoma is the Wichita National Forest and Game Preserve. The Forest Service now has there this herd of buffalo. Around them live over fifty thousand Indians, to most of

"Geronimo" but of a steer named "Champion." The real "Geronimo" belonged to Saunders and was quite another animal being an "outlaw" steer that was never tamed but ran wild in the dense thickets of southern. Texas. During his life he was owned by no less than six different owners as evinced by the six brands he wore but not one of the owners was ever able to get him into a shipping pen. "Geronimo" died of old age amid the thickets of his native range.

"Champion," however, was very gentle and was shipped to the World's Fair in Chicago in 1893. Later on he went abroad and was exhibited at the Paris exhibition and made a triumphal tour of Europe. Coming back to his native land he died at Chicago of old age being then probably between twenty-five and thirty years old.



A PRESENT DAY REPRESENTATIVE OF THE BREED

Figure 8

A Texas Longhorn steer raised on the Wichita National Forest of Oklahoma. He was bought from a passing herd by the Supervisor out of his own funds, and for several years shared with the buffalo the interest of visitors to the forest.

whom the buffalo are almost as sacred as the sacred humpbacked cattle of India are to the Brahmin.

"Why," these Forest officers ask, "should we not have a number of the old Longhorn cattle in a pasture on this Game Preserve, side by side with the buffalo and in the midst of their red-skinned friends of the plains?"

And everybody said. Sure. Why Not?"

But nobody raised the money. Finally, when it seemed as if the plan must fail, they enlisted the services of United States Senator John B. Kendrick, of Wyoming, an old-time Texan cattleman who drove one of the first herds of these very Longhorns from the coastal plains of southern Texas to far-away Wyoming, many years ago.

Due to his persuasive powers Congress appropriated a sum sufficient to secure a small number of these old-timers of the Western ranges, and the Chief Forester is charged with the duty of securing them and placing them in one of the Government pastures in the Wichita Forest.

Here, in the center of the old range of the southern herd of buffalo from which great herds of these Longhorns drove them, they will be preserved for the pleasure and education of future Americans interested in the early history of the West.

A Few Herds Still in Existence

Long ago the forest officers located several small herds of these cattle far down in southwestern Texas where in the noted "Prickley Pear' country they have been so isolated

from other cattle that their blood has been very little "contaminated" (?) by the infusion of blue blood, and to all intents and purposes they are true to type. A six weeks' search discovered about 30 head of these animals. They are now in pasture on the Wichita forest. The type, be it understood, was established early in 1500, when the first Spanish adventurers landed cattle on the coast of what is now Mexico, whence they spread all over our Southwest.

The investment will be a profitable one for the Government, because it is only intended to keep a herd of not to exceed 250 animals, and as these animals are great breeders the surplus will be sold either for beef or to zoos and parks for exhibition purposes, for which there will be a strong demand. Based upon the average returns from a herd of cattle under like circumstances, the Government should receive back the entire amount appropriated within the first ten years of the herd's existence.

What could be more appropriate than to have these three old-timers gathered here on the plains over which they once roamed almost at will. What a world of romance and storied history the idea brings to our memories. They will be preserved here, near neighbors to each other, a living historical Museum of the Plains.

Other Inhabitants Returning

There are also other inhabitants of this Game Preserve. Once the rocky hills that constitute the Wichita Mountains fairly swarmed with our American Wild Turkey. Army men of the early days tell wonderful stories of the incredible number of these fine birds that found their main food supply in the acorns that fell from the oaks growing all over the mountains.

Antelope and elk there were also on the plains around the mountains. But with the advent of the settler and civilization the game animals were quickly swept away, until when the game preserve was created in 1906 not a turkey, not an antelope, not an elk was to be found in the entire region. They were absolutely and completely eliminated from that entire country.

But the stock for a new flock of turkeys came from an Eastern State where a few of the wild birds are even yet to be found. A dozen antelope were caught in far-away Alberta, Canada; and as many elk were shipped from the Yellowstone Park herd. Today one can see flocks of fifty or more wild turkeys in the oak-clad hills, while the elk and antelope have increased at a very satisfactory rate, although for a while the tender little "Prong Horn" had a hard time getting established.

Being the only National Forest and Game Preserve in Oklahoma, the place is a great resort and thousands of people from all over the open plains about it go there each season to camp in the cool canyons and see and admire the game animals.

Race and Constitution

RASSE UND KOERPERBAU, *by* FRANZ WEIDENREICH, Professor in the University of Heidelberg. Pp. 187 with 201 illus., price M.14.40. Berlin, verlag von Julius Springer, 1927.

It has been a question whether the various distinct types of body-build found in such a mixed population as, say, that of the United States, do not merely indicate racial differences, rather than differences in physical constitution. Dr. Weidenreich shows that these distinct types of constitution occur equally in all races, past and present; hence they are not merely racial characters; although he admits that the same trait may be either a racial character or a constitutional character, depending on circumstances, since there is no sharp distinction between the two sorts of characters.

P. P.

TYPES IN ANIMAL BREEDING AND THEIR ANALYTICAL STUDY

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IN the literature of animal breeding we find much about "types." The word is used in a variety of different meanings. Most often "type" is used as an "ideal" or "Standard of Perfection." It is so used when we talk about "breeding to type" as opposed to "breeding to performance." "Type" in this instance as nearly always, is used in the morphological sense. In more or less the same meaning it is understood when we use it, wishing to illustrate different tendencies in selection within a breed. Thus we speak about the Cruickshank type, or the Bates type of Shorthorns.

In addition to this meaning, "type" is also used in a statistical sense. "Typical" we call the variate we meet most often in a statistical series. In this sense we may speak about something as typical not only in the morphological meaning, but about any quality that can be measured or seriated: a typical measurement, a typical form, or a typical performance. It is as a characteristic of type in its statistical sense that we may use the arithmetic mean or the mode, the latter being preferable when we meet with a skew variation.

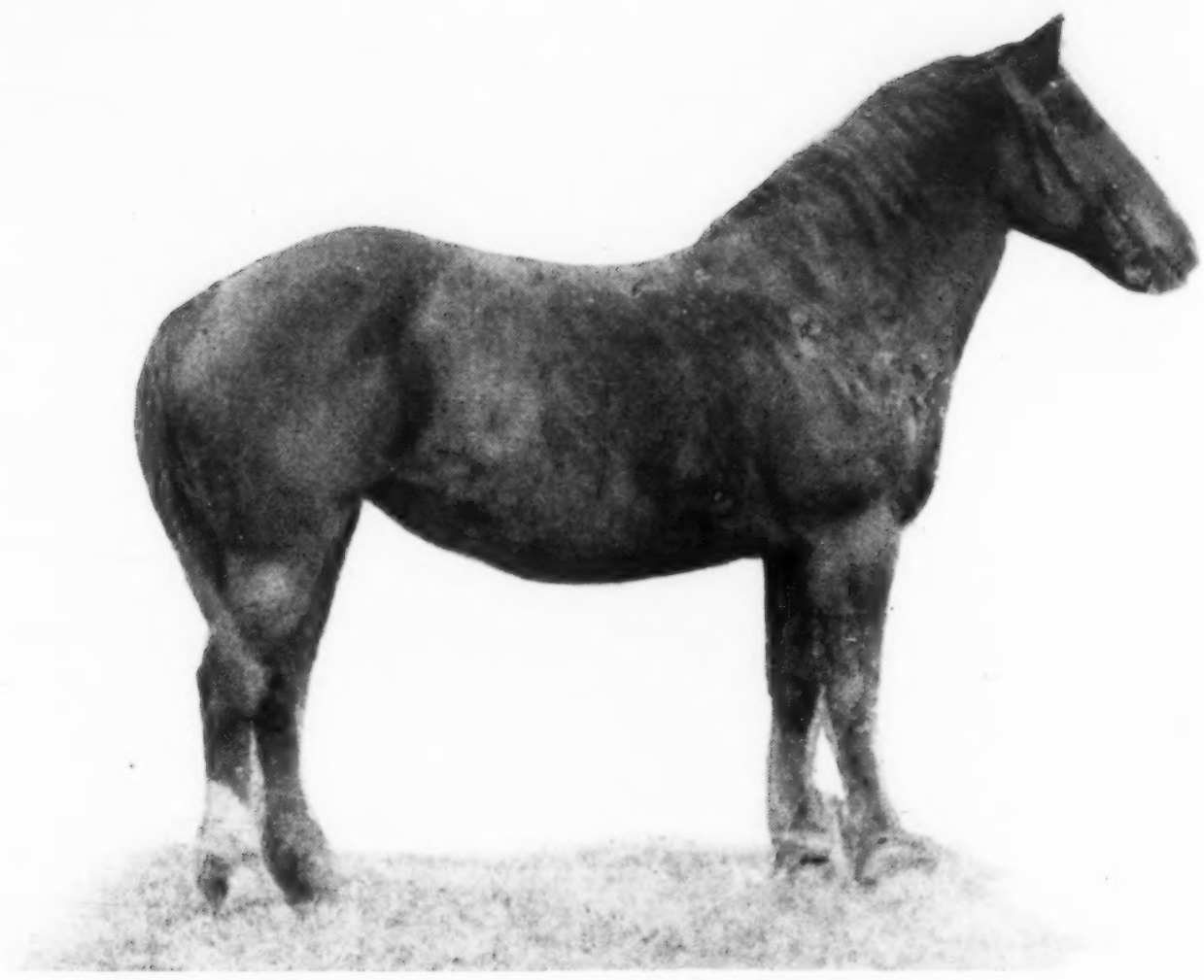
"Type" in the former sense contains a valuation needed for practical purposes, a standard of perfection.—a goal. As such it cannot be the same for every time and every place. It is and can be fitted only for determinate historical conditions and must change in accordance with them. It is an historical "ideal conception" with nothing real that exactly corresponds to it. It is the result of idealistic synthesis. We are not able to show the ideal itself, we may only illustrate it in a more or less happy form. We often do so in our treatises or textbooks when we illustrate the type of a breed by really existing individuals more or less fitting the ideal.

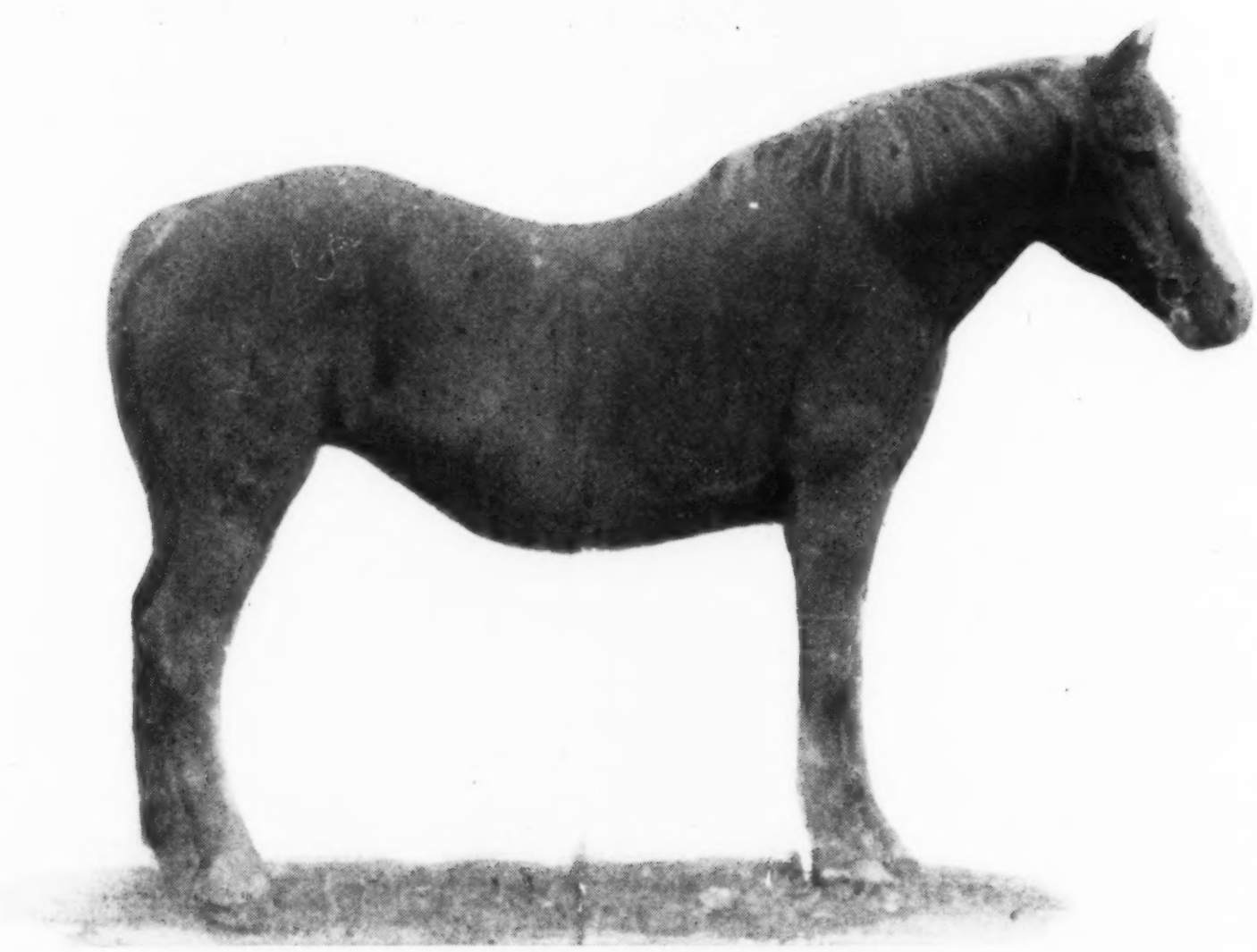
A statistical type on the other hand is the result of statistical analysis and serves to depict something really existing, though complex. As such the statistical type may be opposed to the idealistic type, which is always more or less subjective. The conception of type is used by the breeder in both meanings, often without a clear understanding of the way in which it is used, thus leading to much confusion. The statistical "type" is of much use in describing something of the past or present, in order to allow accurate comparison. The idealistic-synthetic standard points in the direction of something to be attained in the future, though it may also be used for historical descriptions as long as they are concerned with qualitative changes only.*

Analysis of Breeding Phenomena

No practical business may be conducted without having in view a determinate goal. If there were no such goal what reason there could be for the existence of the business? We think that this is understood by every practical man, although he may often not quite have made up his mind as to the ideal he is working toward. But many practical men, as we can see by

*It is widely used for that purpose by historians—see Weber, Max. *Agrarverhaltnisse in Alteratum.* Russian edition, p. 392-393.

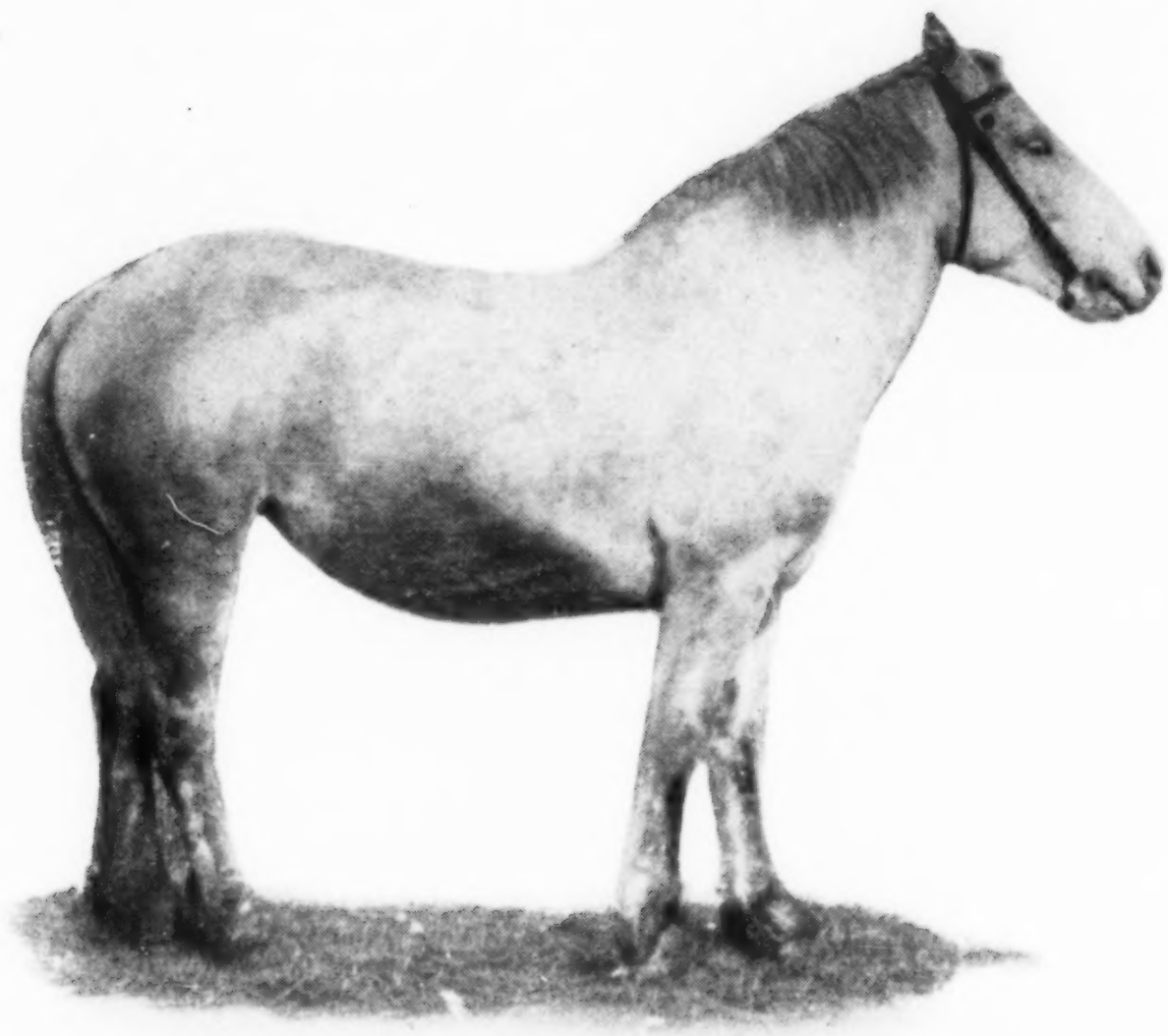


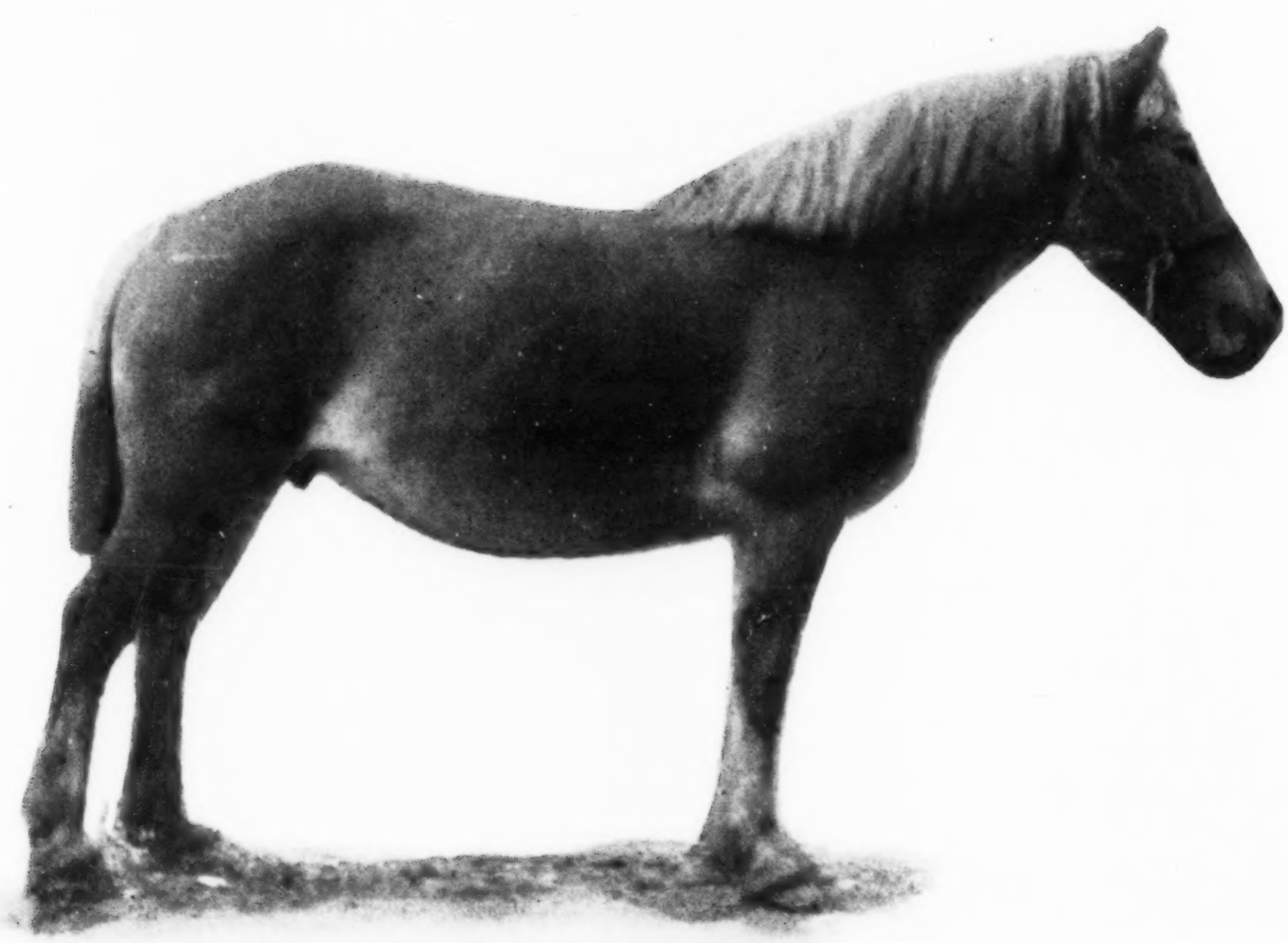


TYPES OF PERSHINO MARES

Figure 9

(Above). Riss II, No. 20 in Table II. This mare is statistically typical of the stud, as she shows a deviation from the Pershino type of 4.28, and from the Khrenovoje type of 22.79. (Below) Rannie Utro, a mare of the stud Pershino that resembles the Khrenovoje type more than that of her own stud. (Deviation from Pershino type = 26.5 from Khenonoe type 12.18) It is possible by this method of statistical analysis to detect differences with a degree of accuracy comparable to that displayed by the trained eye of the expert breeder.





KHRENOVOJE MARES

Figure 10

The gray mare grazia resembles the type of the Perchino stud more than she does that of her own stud (deviation from Pershino type = 4.23; from Khrenovoje type = 17.30.) Genetically it is interesting that all three mares of the Pershino stud that were not properly allocated by this method were daughters of the same sire. The mare Kama (below) is typical of the Khrenovoje stud, deviating only 2.9 from the type of the stud. (Grazia is number 12, and Kama is number 1 in Table II.)

experience, do not think much about the importance of statistically analyzing the phenomena dealt with by breeders. Our object will be to show why this is important.

First of all the result of statistical analysis is quite objective—that is, binding for each normal mind. It helps us to obtain exact knowledge of the rather complex breeding phenomena where there was formerly only blind faith. It may also help us in constructing a useful idealistic standard. But we certainly must not take the mean as the standard. There cannot be a single standard of perfection that could answer to all our needs in all circumstances. As our circumstances change, our ideal changes also. In selecting an ideal type we must avoid aiming at too high a standard; it must be more or less capable of attainment. We can hardly aim at the highest refinement of beef cattle in a poor ranch district. The standard of beef type for ranch purposes must be something different from that which would be suitable to conditions in a rich agricultural district. The same is true of ideals under differing climatic conditions.

In analyzing a population statistically we may discover that our "standard" does not correspond to our needs, and thus our statistical study may lead us to modify our ideal. Our ideal must be quite fitted to our surroundings, and statistically we may find out the fittest.* If this does not correspond to our ideal, then we have either to change our standard or try to discover the element which governs natural selection, and eliminate or better it. For instance, in statistically analyzing the height at the withers of brood mares belonging to the peasantry in the government of Toola (Central Russia) in my work on mass selection, I was able to establish that although the mean height at the withers of all brood mares was 153.04 ± 0.51† cm., the same measurement was only 150.87 ± 1.45 in the mares with foals during the summer of 1924.[6] We have here an instance of genetic or reproductive selections.‡ The conditions in Central Russia do not favor brood mares high at the withers. If we choose a high standard in that direction we must count on the lessening of fertility or we must try to find out what element of our conditions leads to it and try to eliminate it. (Perhaps better feeding during the winter?)

The mean as it is, is not and must not and cannot be an ideal of perfection, it is the result of all the historically present diversity of facts. It shows the point to which evolution has come. If the breeder aims to control evolution and to direct its flow he must know to what level evolution already has come and with what difficulties he has to strive. The statistical type is the result of the breeding of many bad individuals as well as others of a more desirable constitution. The breeders's ideal is to have only good stock, but he must be able to appreciate how difficult it is in his concrete surroundings. The statistical method may help him in his task. In the past much of this analysis had to be done by each separate breeder for himself. As statistical and mathematical studies were not so wide-spread among animal breeders, each individual breeder had to develop his "keen eye" to be able to evaluate how much he was progressing with or against natural selection.

Any country that is interested in productive and well-adapted animal breeding cannot fully rely on so subjective a thing as a "keen eye." It must have something less open to dispute and more objective, especially in a country in which there are many small breeders who have little opportunity for really obtaining a "keen eye." The state needs objective statistical studies also to control the "keen eye" of judges as we may see

*Pearson,[8] page 450.
†The errors given are standard errors.—*Ed.*
‡Pearson,[8] pages 513, 518, 544.

from the analysis of cattle judging methods recently reported by J. W. Gowan.[2]

Application of Genetic Discoveries

With the development of genetics the breeders's horizon enlarges, and he sees many new possibilities. Plant breeders have already made use of many of the genetic discoveries. Animal breeders have as yet for many reasons, not been able to do so to as great an extent.[5] The principal reason for this is that experimental work with the higher animals is much more expensive and needs much more time than in the case of cultivated plants. Also the emperical practice of animal breeding is much more advanced than were such methods in plant breeding. The empirical methods of animal breeding were until quite recently much in advance of our scientific means of analyzing and evaluating them (for instance in such questions as inbreeding or of morphological types). The skilful empiric was able to discern in horses very small deviations of type, which our rather coarse biometrical means were impotent to discern. For instance, a German scientist, Dr. Kohn,[7] was so bold as to suggest entirely discarding our conceptions of types of breeds in horses because he was not able to differentiate breeds by measuring the height at the withers of a single individual.

The object of this article will be to show how we are able to discern rather small differences of morphological type in horses by statistical methods. The method used is more fully described in my Russian publication.[6] I am glad to be able to illustrate the mathematical part of my work by photographs which will say more to the practical breeder than the dead measurements and indices.

Our material consists of the mares of two stud-farms of the same breed of light draft horse—the Ardenn. These two studs, although of one and the same breed are situated in different places. One is located in the government of Woronetsh (Khrenovoje) on very fertile black soil (Tshernozem); the other, Pershino, at the north of the government of Toola just out of the northern border of the Tshernozem. Selection in the two studs has not been conducted on quite the same lines. At Pershino an effort has been made to breed more true to the ideal of the old type of small Ardenn. At Khrenovoje there was more tolerance to the admixture of the blood of the more modern type of Belgian draft horse. In the last century there has also been an admixture of Percheron blood. Both studs have largely used home-bred mares, derived from importations made from 1860 to 1880. Imported stallions were used to a large extent until the outbreak of the war. The degree of inbreeding (Wright's coefficient) has varied between 7.5 and 6.8 among the mares of the Pershino stud. Khrenovoje stud has been less inbred, so that genetic similarity within this stud is largely due to common sires (most of the mares studied contained the blood of two sires, Robert de Roulingen, and Salem) and to blood connections in the female line.

To characterize these two populations four measurements were taken: (1) the height at the withers; (2) the heart girth; (3) the circumference of the cannon bone; and (4) the length of the body.

As raw measurements give rather a poor idea of the form, indices were calculated which give a much fairer knowledge of the proportions[1].

The indices are as follows*:

$$(1)\ \text{Relative weight} = \frac{\text{weight} \cdot 100}{\text{height}^3}.$$

*As several of these indices had weight as a component, and as actual weighting was not possible, the weight was calculated by the formula of Prof. Chludsinski ($A^2C \times 0.0000825 =$ Kgr.), where A=heart girth: C=body length in centimeters: 0.0000825=an empirical coefficient.

(2) "Cannon loading"[1] $= \frac{\text{circumference of the cannon bone} \times .100}{\text{weight}}$.

(3) Relative thickness of the leg $= \frac{\text{circumference of the cannon bone} .100}{\text{height}}$.

(4) Relative compactness of the body $= \frac{\text{body length} .100}{\text{heart girth}}$.

(5) Relative shortness ("format") $= \frac{\text{height} .100}{\text{length of body}}$.

To characterize the size, height and weight were also taken in consideration. The normal curves for the variations of all these indices (and the two measurements) were calculated. The resulting data are seen in Table 1.

This table (see also the graphs) represents the type of the two populations. If we wish to know whether there is any difference in type we must compare them, taking in account the mean errors.

These calculations give us:

1. Height at the withers	Pershino—Khrenovoji	=	—2.34±0.81
2. Weight	" "	=	—4.02±0.92
3. Relative weight	" "	=	—13.8±4.06
4. Cannon loading	" "	=	4.32±1.30
5. Relative cannon thickness	" "	=	—0.65±0.14
6. Relative compactness	" "	=	1.15±1.07
7. Relative shortness	" "	=	1.87±1.14

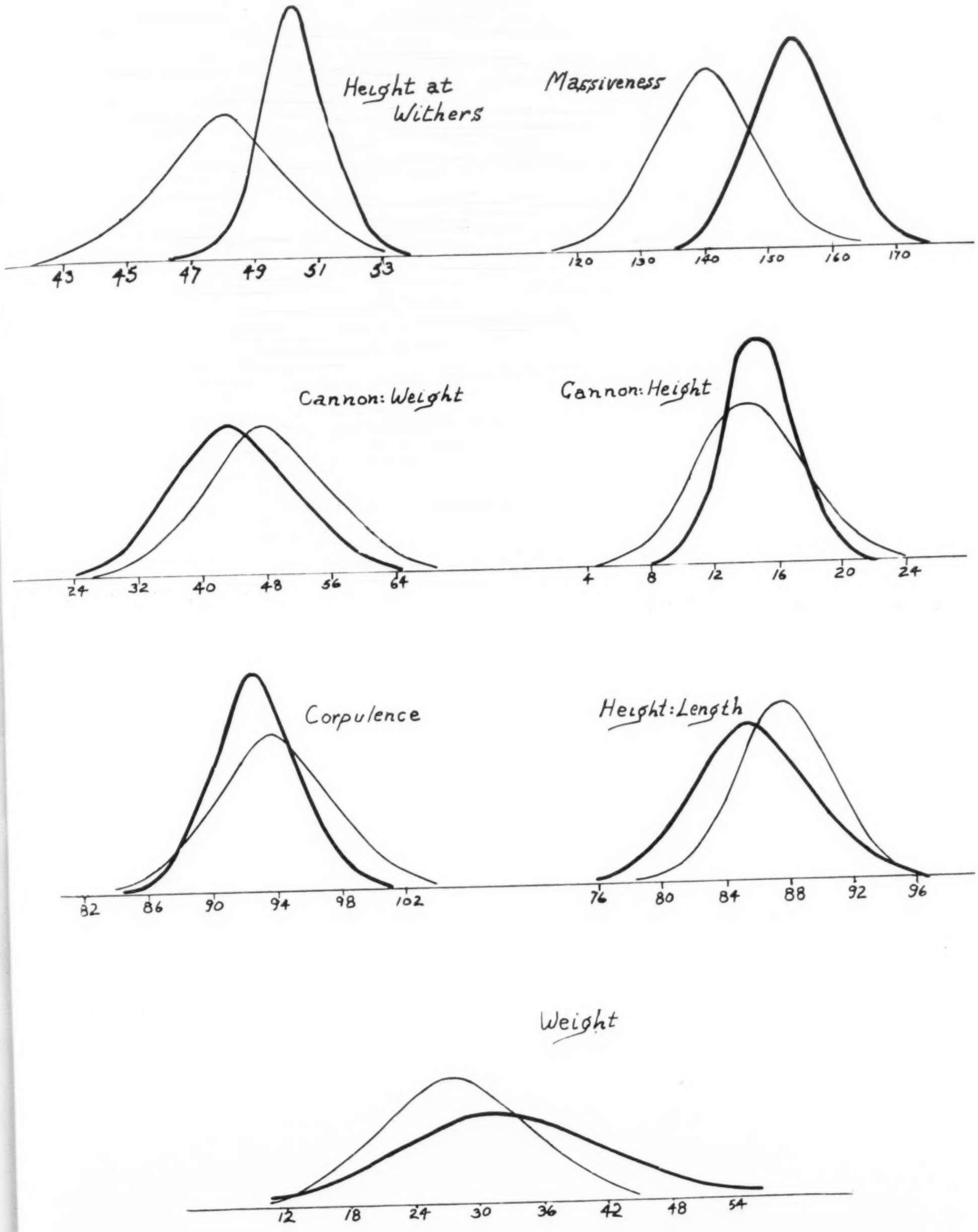
From these results we may say that the type of the stud Pershino is significantly other than that of Khrenovoje in weight (2), relative weight (3), cannon loading (4), cannon thickness (5). The differences are from 3.3 times to 4.7 times the "mean error" (or from 4.9 to 7 times the "probable error"). The differece in the height at the withers (1) is probably significant (2.8 times the mean error), the same is true for relative shortness (7) —1.6 times the mean error. For compactness of body build there may be no difference (1.074 times).

The Method of "Combined Types"

If we get a fair sample of a stud (or of any other population) of the Ardenn breed having the same type we may discern to what type this lot belongs if we have one of the indices in which there is a significant difference. But about a small sample or a single individual we may say nothing. The curves of our measurements (or indices) transgress and a single individual has a rather large chance to fall in the area covered by both curves. We would be in such a case quite in the position of Kohn. But we have not only a single

TABLE I. Average measurements and indices of the characters under consideration in stud Perishino and stud Khrenovoje

	Stud Pershino			*Stud Khrenovioje*		
Measurement or index	*Mean (25 individuals)*	*Std. Dev.*	c	*Mean (12 individuals)*	*Std. Dev.*	c
1. Height	148.0±0.63	3.15	2.17	150.34±0.51	1.75	1.17
2. Rel. weight (Russ. poods)	27.78±0.41	2.06	7.41	31.8 ±0.82	3.46	10.9
3. Relative weight	140.4±2.41	12.05	8.58	154.2 ±3.27	11.15	7.30
4. Cannon loading	47.82±0.79	3.99	8.34	43.5 ±1.04	3.56	8.18
5. Rel. Cannon thickness	14.36±0.1	0.51	3.55	15.01±0.1	0.355	2.37
6. Compactness	93.9 ±0.74	3.72	3.96	92.75±0.77	2.65	2.86
7. Rel. Shortness	87.7 ±0.56	2.83	3.23	85.83±0.99	3.38	3.94



FREQUENCY DISTRIBUTIONS OF STUDS WITH RESPECT TO SEVEN CHARACTERS AND INDICES

Figure 11

The combination of all these measurements gives a complex characteristic of the two studs which is a far better picture of the types than the single measurements.

———— Type of Stud Pershino.

———— Type of Stud Khrenovoje.

measurement as he had, but a series of seven. These seven measurements (or indices) give us a far better characteristic of the type than a single one. We have a complex characteristic of our population (a "Complex Typus," as the great Danish genetist Johansen said[4]) and not a "single type" (Einfachtypus). If we could give an infinite quantity of we would have a" full type"—Gesamtypus of Johansen. An experienced breeder with a "keen eye" speaks generally of a "full type" when he does not use the word type in an idealistic sense.

A German naturalist, Heincke, proposed (1898) a method, called the method of "combined symptoms" which enables us to solve the problem of determining the type of a single individual by making use of the complex type[3].

Heincke worked on herrings from along the northern coasts of Europe. His investigations led him to discern a multitude of quite different races. He studied almost sixty different qualities (meristic characters(as number of vertebrae, etc.; features of proportion (indices); and variations in the relative positions of different organs (topographic qualities). In several of these qualities the different races had transgressive curves, but nevertheless they gave quite significant differences in the means of the types. For instance the herrings from the coast of Scotland have as a type 14.8 scales between the pectoral fin and the anus, the herrings from Stockholm 13.4, from the White Sea only 12.4, and so forth, with rather wide transgressions. Heincke thought that the different "characters" in a race all tend to be scattered round their respective means more or less independently of each other. If the deviations of the several characters vary independently, they must follow in their distribution the laws of chance. This gives the possibility of diagnosing the race of a single individual. From mathematical statistics we know that the standard deviation is the "least possible root-means square deviation" from the arithmetic mean[9]. If we take, therefore the sum of the squares of the deviations from the means of several types, the sum will be smallest for the individuals of the same race.

Heincke showed in fact that it was so. He propounded the thesis that for diagnosing the race of a single fish we need to study a quantity of characters. To do the same on a small sample we need several qualities, and on a large lot we may determine the race by a single character.

We may use the same method in our case. But as our indices are numerically very different (from 14.36 to 154.2) and their variability very great (the standard deviation ranges from 0.35 to 12.05) it is not rational to use the deviations just as they are, but we are obliged to bring them all upon a common level, "to balance them."

We may do so by dividing each deviation by its respective standard deviation. This we did and obtained the data given in Table II.

As is seen from the table we are able to determine fairly accurately the type of most of our individuals. This we can say especially taking in mind the rather small material and scanty measurements.

The exceptions are illustrated in the adjoined photos in comparison with the typical individuals of both studs (in the purely statistical sense as "Complex types"—not as ideals).

We think that morphologically these exceptions are really rather large deviations from the stud type, so that the statistical analysis was right and we may say that the method of "combined symptoms" enables us to discern so delicate morphological differences as exist in two studs of the same breed, which up to this time could be done only on the quite subjective basis of the "keen eye" of an experienced breeder.

Genetically it may be of interest that all the three mares of the stud Krenovoje which were not properly identified by this method were daughters of the

same sire (Garus). We think therefore that our method in giving us the possibility of an objective evaluation of very small differences and similarities in morphological types may enable us to make a genetic study of the hereditary transmission of rather delicate characters.

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TABLE II. Individual indices of mares of Pershino and Khrenovoje studs. Deviations from the types are shown in Columns 2 and 3.

	Names of Mares	Squared Deviations from Khrenovoje Type	Squared Deviations from Pershino Type	Height	Weight	Rel. Weight	Cannon Loading	Rel. Cannon Thick	Compactness	Rel. Shortness
Stud Khrenovoje	1. Кама.	2,909	19,81	150	33,69	163	41,7	15.33	90.3	85,2
	2. Родня	2,318	5,37	150	30,5	148	45,3	15,00	96,1	85,7
	3. Родинка . . .	6,466	23,81	152	34,16	159	42,9	15,71	92,2	85,4
	4. Раба.	5,459	16,61	153	33,5	153	41.9	15,03	89,7	87,4
	5. Гардина . . .	3,306	9,00	150	30.9	150	45,4	15,33	89,5	88,2
	6. Растрата . . .	5,735	28,98	150	35,03	170	39.2	15,00	93,9	82,0
	7. Ромашка . . .	6.971	19,14	150	33,93	165	39,6	14.31	90.3	85,7
	8. Самара . . .	10,357	29,63	154	35,78	160	38,4	14,61	94,1	83,2
	9. Соха.	1,397	8,52	149	31,6	156	42.5	14,76	91,6	85,6
	10. Галушка . . .	4.529	1.45	148	28,66	145	46,9	14 86	92,6	87,1
	11. Гарнет	6,24	2,93	148	28,37	143	48,5	15.20	93,1	87,1
	12. Грация. . . .	17,30	4,23	150	26,68	126,9	50,4	14,67	98,8	86,7
	13. Пальма	17,06	8,47	147	29 5	152	43,5	14,29	85,8	90,2
	14. Наяда	9,178	0,75	150	27,7	134	47.4	14,34	94,4	88,2
	15. Кн. Мери . .	27,422	5,79	150	27,89	135	43.8	13,33	95.0	87,7
	16. Куколка . . .	10,47	1.89	150	28 5	138	45.0	14,00	95,6	86,7
	17. Роковая . . .	32,74	6,23	143	26.2	146	46,6	13.99	97,1	84,1
	18. Княжна. . . .	19,01	3.72	148	26,1	133,3	48.6	14,19	90,0	91,4
	19. Рига.	36,03	7,1	142	26,1	149	46,8	14,09	88,9	88,8
	20. Рысь II. . . .	22,71	4,28	146	25,0	132	51,3	14,38	92,6	90,1
	21. Радость . . .	26,02	8,6	141	24,7	130	54,1	15,10	94,2	89,6
	22. Рутина. . . .	14,86	7.24	152	30,5	112	42,0	13.82	95,7	85.9
	23. Рысь I	11,55	5 03	151	30,15	143,0	42,6	13,91	94,6	86,3
	24. Терпсихора . .	11.65	0,72	149	27,1	134.0	48,4	14,43	95,5	87.7
	25. Жестокая, . .	15,67	4,58	150	27,3	132	50,3	15,0	99,4	85,7
	26. Миледи. . . .	20,17	2,92	149	26 5	131	48.4	14.10	98.3	86,6
	27. Попытка . . .	20,43	3,01	146	25,7	135	49.9	14,38	91,5	90,1
	28. Сорока	5,31	2.16	150	28,5	138	48,2	15,00	93,95	87,7
	29. Гуща.	8,35	4,55	149	29,8	147	43,0	14,10	93 5	86.1
	30. Хива.	11,09	4,32	150	29.67	144	43.2	14,00	96,2	85,2
	31. Жадная. . . .	16,16	5,68	149	26,4	131	50,9	14,76	90,0	92.0
	32. Ракета	11,55	5,03	151	30,15	143	42,5	13,91	94,6	86,3
	33. Робкая	66,31	29,90	149	21,9	108	55,8	13,42	93,1	95,5
	34. Рулетка . . .	38,87	9,78	141	24,8	142,3	51,6	14,89	95.2	85,4
	35. Тара.	39,70	23,01	141	29,9	175	42,9	14,90	85,6	85,4
Stud Pershino	36. Раннее утро .	12,13	26,5	151	30,68	146	44,8	14,90	101,1	82,1
	37. Клевета. . .	0,89	10,81	150	31,87	155	44,1	15,33	93,1	85,7

GROWTH INCREASED BY REMOVAL OF FLORAL BUDS

Figure 12

Six pots of Acala Upland cotton grown in the water requirement series at Sacaton, Arizona, 1926. The cultural treatment of the six pots was the same. The plants in the three pots at the left were allowed to flower and bear fruit, while all of the floral buds were removed from the plants at the right. The plants at the left, after shedding about 30 per cent of their floral buds produced an average of 35 flowers each. The plants at the right averaged 211 floral buds. Photographed July 30, 1926, by H. F. Loomis.

DEFRUITING AS AN AID IN COTTON BREEDING

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ONE of the problems of cotton breeding is to prevent cross-pollination. Hybridization is responsible for most of the diversity found in cotton, and the mixing of varieties through cross-pollination causes a rapid deterioration of the seed stocks. To guard against the possible crossing of different selections and strains and of off-type plants which may appear within a strain it is necessary for the breeder to depend on seed pollinated by hand or by some method which prevents cross-pollination, where good isolation is impracticable. The labor involved in hand pollination is considerable and much of the work may be in vain, on account of the fact that a large percentage of the bolls may abort during their early development. Cook,[1] in discussing causes of shedding, has observed "Egyptian cotton may retain nearly all of its buds and young bolls, while Upland varieties in adjacent rows are shedding nearly all of their buds." In the southwestern United States it very commonly happens that less than a third of the flowers of Upland cotton develop into mature bolls. An adequate discussion of the literature dealing with causes of shedding of cotton bolls is beyond the scope of this paper, but since nutritive and correlative relationships between fruitfulness, growth and abscission are to be dealt with, citations to publications by Ewing,[2] Mason[3, 4] and Murneek[5] are given.

In the course of an investigation of some of the factors associated with the shedding of floral buds and immature bolls of cotton in the Southwest, it has come to be recognized that a very intimate relationship exists between the fruitfulness of the plants and the factors which influence the rate of photosynthesis. Certain of the experiments have served to bring out very clearly that the nutritional relationships of the cotton plant in these regions are responsible for a considerable part of the boll shedding, which occurs every year, and that the amount of fruit which is already carried by a cotton plant greatly influences the further growth which the plant can make, the number of flowers to appear and the number of bolls to be retained.

Defruiting Increases Number of Matured Bolls

Results of experiments conducted at the U. S. Field Station, Sacaton, Arizona, are to be reported here for the purpose of illustrating an application of this relationship which may be helpful to cotton breeders, since the shedding of self-pollnated flowers, or of flowers which have been cross-pollinated by hand causes a great amount of extra labor and in some cases may greatly retard the progress of breeding work. The experiments show that if all of the bolls are removed from cotton plants a greater number of flowers may subsequently appear on these plants than on control plants, and that a larger percentage of the flowers on the previously defruited plants develop into mature bolls than on untreated plants. With the removal of the previously set fruit the products of photosynthesis which prior to defruiting were translocated to the developing fruit are liberated, so to speak, for new growth and flower production, with an accompanying decrease in the number of floral buds which otherwise would have been shed.

Figure 12

Six pots of Acala Upland cotton grown in the water requirement series at Sacaton, Arizona, 1926. The cultural treatment of the six pots was the same. The plants in the three pots at the left were allowed to flower and bear fruit, while all of the floral buds were removed from the plants at the right. The plants at the left, after shedding about 30 per cent of their floral buds produced an average of 35 flowers each. The plants at the right averaged 211 floral buds. Photographed July 30, 1926, by H. F. Loomis.

In one of the experiments two series of twenty-five plants were selected in a field plat of Acala Upland cotton thinned to one plant per foot in rows three and one-half feet apart. Twice during the summer all of the bolls were removed from one of the series, while the other series was allowed to develop normally as controls. The plants were first defruited (all bolls removed) on the thirty-fifth day of the flowering period. The second defruiting followed thirty-five days later, or about twenty days from the end of the flowering season. The individuals of the two series alternated with each other at distances of four or five feet, usually with four or five plants intervening. Daily shedding records were taken throughout the summer on each of the plants in the two series. The effect of defruiting upon the plants so treated in comparison with the control plants is summarized in Table I.

During the 20-day period following the first defruiting the 25 defruited plants produced 485 flowers, and from these retained 199 bolls. The control plants during the same period produced 383 flowers and retained 108 bolls, the difference in the number of bolls retained by the two sets of plants being 91, or 84 per cent in favor of the defruited plants. The control plants shed 72 per cent of the bolls from flowers appearing during this period and the defruited plants 59 per cent. The difference in the number of retained bolls was greatest during the first ten days after defruiting, 95 bolls being retained by the defruited plants corresponding to 37 bolls retained by the control plants. During the same ten-day period there was a difference of but 28 in the number of flowers produced, 218 appearing on the defruited plants and 190 on the controls. This small increase in the number of flowers produced can well be attributed to a reduction in the shedding of floral buds. During the full 35-day period the 25 defruited plants produced 821 flowers and the control plants 575 flowers. The number of bolls which would have been matured from the total flowers on the defruited plants is uncertain, since the same plants were again defruited on August 26.

Following the second defruiting, the defruited plants produced 147 flowers, from which 118 bolls were matured. The control plants during the same period produced 150 flowers, from which 61 bolls were matured, the difference in the number of bolls retained by the two series of plants being 57, or 93 per cent. During this period the control plants shed the bolls from 59 per cent of their flowers, while the defruited plants shed but 20 per cent. At the time of the second defruiting, the plants were approaching maturity, which probably accounts, in part, for the lack of difference in the number of flowers produced after August 26 by the two sets of plants. On August 26, the previously defruited plants were carrying 376 bolls and the control plants but 280 bolls. The heavier load on the defruited plants had doubtless already caused a heavier shedding of floral buds than that which had occurred on the control plants.

The effect of maturing fruit upon the growth and flowering of cotton plants may be illustrated by another experiment, in which all of the floral buds were removed as fast as they appeared from a number of Acala Upland cotton plants growing in cans in a water requirement series. The plants with buds removed (Figure 14) made a greater vegetative growth and produced over four times as many floral buds as did control plants.

Application of Defruiting in Breeding

A red-leafed Upland cotton being grown on the station in 1926 exhibited physiological characters of some interest, which made it desirable that seed from self-fertilized flowers be secured for later studies. The flowers from twelve plants in a wide spaced row were selfed from August 23 to September 15. On August 27, a need for additional seed was foreseen and selfing was started on four succeeding

plants, from which all bolls were removed on this date. Comparative notes were taken on the two groups of plants on September 11. A summary of these data, together with the number of bolls matured, is given in Table II.

This test, while it involves only a limited number of plants, brings out very well the relation previously observed between the setting of new fruit and the amount of fruit on the plant. At the time this selfing was started it would have been easily possible for a breeder to have selected for productiveness and for plant types. The season was not too far advanced to secure sufficient seed for a fair-sized progeny row from any of the defruited plants in this test. With the close spacing used in the first experiment fewer bolls were obtained per plant. Cotton breeders gain a distinct advantage when they can delay making their selections of plants for breeding purposes until the middle or latter part of the flowering season, for it is only after a considerable part of the crop has been set that many plant characteristics can be evaluated.

Other Results Possible Under Different Conditions

The correlation between growth, fruitfulness and shedding may suggest answers to many questions on shedding. The problem, as a whole, however, is very complex, and no single criterion, with our present knowledge of the subject, will explain all of the facts which have been observed. Indirect evidence suggests also that, under certain conditions, defruiting might have an effect different from that found at Sacaton. Data gathered in California during a previous season, for example, indicates that, under very favorable conditions, more organic substances may accumulate in the leaf tissue than can find an adequate outlet in the fruit carried by the plant. Placing such plants in the dark for one or two days to reduce the osmotic pressure of the sap resulted in decreased, rather than increased, shedding rates. A similar treatment at Sacaton, where considerably lower sap concentration prevailed, resulted in an almost complete and immediate shedding of all floral buds and previously set fruit. A new maximum in the flowering curve and a heavy setting of new bolls followed the treatment at Sacaton. Information obtained at Sacaton indicates that cotton plants in this region operate with a low carbohydrate reserve. It would appear that this might be due to temperatures above the photosynthetic optimum, but favoring a rapid translocation and utilization of the photosynthetic products in vegetable development and fruit production.

TABLE I. Effect of Defruiting upon the Growth, Flowering, and Shedding of Acala Upland Cotton.

	BEFORE DEFRUITING			20 day period after 1st defruiting			20 day period after 2nd defruiting		
	Number of Flowers before July 23	Number of Bolls Shed before July 23	Mean Height of Plants July 21 cms.	Number of Flowers between July 23 and Aug. 11	Number of Bolls Retained*	Mean Height of Plants Aug. 11 cms.	Number of Flowers between Aug. 27 Sept. 15	Number of Bolls Retained*	Mean Height of Plants Sept. 15 cms.
CONTROLS (25 plants)	356	212	76	383	108	93	150	61	100
DEFRUITED JULY 22 AND AUGUST 26 (25 plants)	346	203	77	485	199	99	147	118	108

*Bolls retained for 16 days or longer from flowers appearing during the respective periods July 23 to August 11 and August 27 to September 15.

TABLE II—A Comparison of Normal and Defruited Plants with Respect to the Shedding of Selfed Bolls*

	Numbers of Flowers per Plant to 9-11	Number of Bolls per Plant Retained to 9-11	Percent of Bolls Retained to 9-11	Number of Bolls per Plant Matured from Flowers to 9-15
	mean	mean		mean
CONTROLS (12 plants)..... Selfed from August 23rd.	13.6	4.5	33	3.2
DEFRUITED (4 plants)..... Selfed from August 27th.	24.0	21.5	90	24.0

*NOTE—The defruited plants appeared to be a little larger than the normally treated plants. This difference in size, however, was not great and was doubtless more than made up by the fact that the selfing was started four days earlier on the normally treated plants.

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The Honey Locust Contest

THE honey locust contest announced last summer aroused quite wide interest. Inquiries, photographs, and samples of pods were received from 36 states and from Quebec Province, Canada. The only states not heard from were the New England States and Florida, east of the Mississippi; and Nevada, Washington, North Dakota, New Mexico, Wyoming and Utah in the West. This indicates that the species has a rather more extended distribution than is recognized in books on forestry. The honey locust appears to thrive in all parts of the country except in some of the northeastern states and in the more arid regions.

A quite remarkable diversity in many characters is to be noted. The largest beans submitted are nearly two feet long and some of the smaller ones only as many inches. As yet no analyses to determine the sugar content have been made. Judging from the taste, this must vary over rather wide limits. Some of the pods are entirely lacking in a sugary flavor and others are almost sickeningly sweet. The ratio of the weight of pods to beans also varies greatly. Some of the fleshy pods represent in the neighborhood of 75% of the total dry weight, while in others the pods dry up to almost nothing and the beans represent a much larger part.

The productivity of the trees also varies immensely. It is not possible to tell yet whether the same trees bear heavily from year to year or whether there is a variation in this respect. It is hoped that information on this point will be forthcoming in the next few weeks as replies on the second year are being received.

It will be recalled that the contest closes on December 31st next. At that time the prizes totaling $50.00 will be awarded. The requirements of the contest were published in full in the July 1926 Journal of Heredity. Judging from the amount of data on hand the council of the Association have much material to choose from, and it will not be an easy matter to determine the most valuable trees.

"HERNIOUS" SEEDS IN MAIZE

Another Hereditary Endosperm Character

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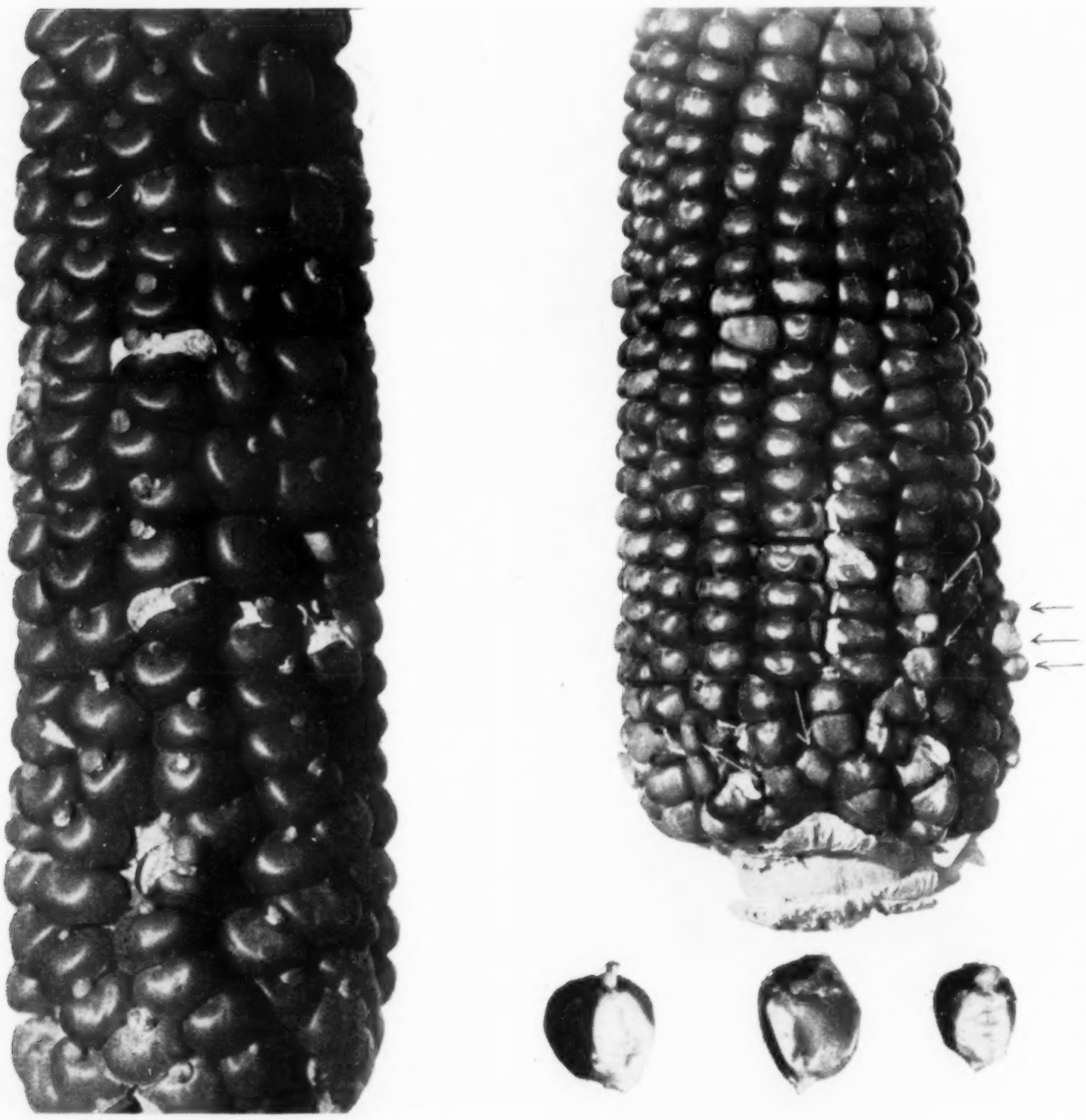

EXAMPLES OF "HERNIOUS SEEDS"

Figure 13

On the cob at the left nearly every grain has a small "hernia" of endospermatic material at the point where the style entered the ovary. On the cob at the right the "hernias" are larger. The arrows point out some of them which might be mistaken for grains. Below are three separate grains, showing the "hernias" from the side.

AMONG the multitude of heritable characters hitherto known in maize, we have never seen described the one reported below. This is a defect of the seeds that we are not able to define better than by calling it *"hernious seeds"* or *"stylar hernia."*

In the "hernious" seeds we note, at a point corresponding with the scar of the style (namely of the old insertion of the style in the ovary) a protuberance, mostly globular or lenticular, apparently formed by endospermatic material, not covered by pericarp: we might call this phenomenon an extroflexion of the endosperm.

Probably, by the effect of internal

pressure, this material issued from an opening formed in the pericarp at the time of the falling of the style, when the endosperm was still of a milky or pasty consistency. Afterwards the "hernia" becomes hard and keeps its definitive consistency which is flinty or, less frequently, mealy.

The internal consistency of the "hernia" is very important for, according to its nature, causes a various behavior of this material.

If it is of hard and vitreous consistency, it remains firm even after a vigorous drying up. If, on the contrary, it is mealy, with the drying up it splits at the union with the caryopsis and the "hernia" becomes detached and falls off very easily, leaving on the kernel a little white spot.

In some cases, in the strains observed, this phenomenon is accompanied by the "defective" seeds, and, more frequently, by "broken" seeds, the last already described by us. Sometimes the split of a "broken" seed can injure both the caryopsis properly named and the "hernious" formation. At other times the kernel does not show any trace of a split, but the "hernia" may be broken and also moulded. Likewise we observe a similar behavior of the defective seeds.

The size of this formation is very variable: some are a simple and hardly perceptible protuberance of the style scar, and some are even as large as a lentil seed: the last covers almost the entire crown of the caryopsis. Between these two extremes we see all the gradations in size, but generally these "hernias" vary between the sizes of a clover seed and of a mustard seed.

We have noted that the largest "hernias" are nearly always flinty: in practice the large mealy ones, when they do not fall off, burst and become badly moulded, together with the kernel.

Finally we will say that the shape of the "hernia" would always be spherical or globular, except that it is often compressed, when still soft, by the husks, of which the "hernia," as does the crown of normal flint kernels, frequently keeps the impression.

We have met with this new character in various strains of our selection work on the varieties *"Nostrano dell' Isola," "Pignoletto d' oro," "Scagliolo"* and some others. This phenomenon varies from a strain to another in some detail, but always it is uniform in a single strain.

We think that this character is of hereditary nature and have in course the necessary work to prove the truth of our affirmation.

Fresh from the Oven

ABSTRACTS OF THESES, The University of Chicago, Science Series, Vol. III (1924-5); pp. 351. Price $3.00. University of Chicago Press, 1927.

Trophies of the Ph. D. hunters. The cast of the contemporary academic mind is revealed by the fact that chemistry leads with 16, pure mathematics follows with 10; all the biological sciences put together have only 14, of which genetics none at all.

P. P.